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NATIONAL ELECTRIC LIGHT ASSOCIATION

Thirtieth Convention
Washington, D. C.
June 4, 5, 6, 7, 1907

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NATIONAL
Electric Light
ASSOCIATION

THIRTIETH CONVENTION

VOLUME II

Commercial Programme

Question Box

WASHINGTON, D. C.
JUNE 4, 5, 6, 7, 1907

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Commercial Programme

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COMMERCIAL PROGRAMME OF THE THIRTIETH CONVENTION, NATIONAL ELECTRIC LIGHT ASSOCIATION

The thirtieth convention of the association was held at Washington, and Friday, June 7, was set aside on the programme as "Commercial, or New-Business Day." At the request of President Williams, Mr. W. W. Freeman took the chair, and opened the session with the following remarks:

CHAIRMAN FREEMAN: I believe that one of the essentials of success in commercial life is the ability to adapt oneself to circumstances. I have been given a programme marked out in minutes—almost in seconds—which appears to make it difficult to get through with the matter in hand, even if we had begun promptly at ten o'clock. Due to the introduction of the most important subjects that we have been considering, we are one hour behind the schedule, and it behooves us to show our commercialism by getting through with the programme within the time limit at our disposal.

We will begin with The Commercial Field, followed by Questions of Policy. I have now the pleasure of calling upon the originator and moving spirit of the Co-operative Electrical Development Association, Mr. J. Robert Crouse, who will read a paper on *Co-operative Commercialism in the Electrical Field.*

The Commercial Field

CO-OPERATIVE COMMERCIALISM IN THE ELECTRICAL FIELD

Introductory

Through the continued courtesy of your officers, yourselves and your special committees, it has been my pleasure on two previous occasions to raise the question of closer commercial co-operation for your consideration, at Denver in 1905, and Atlantic City in 1906. The conditions that suggested the idea, the organization that nurtured it, the trade relations existing, and the essential points pertaining to its earlier development, are of record in your previous proceedings, and will, therefore, not be again reviewed. The force of the idea, the practical nature of the plans, and the efficient results obtained, are such, I confidently believe, as will increasingly commend the subject to your best sentiments and business judgment alike. The entire proposition, may I ask you at the start to view as the product of the co-operation of many men who have been willing to venture their time and considerable sums of money in bringing to a practical working basis. The degree of its future success will likewise depend upon the extent to which it can effectively appeal to all the branches of the trade for both their moral and financial co-operation.

Objects

The objects of this co-operative movement, briefly stated, are as follows:

First—The promotion of the increased and more extended use of electric current by the public for light, heat and power against all competitors for like service, as an end in itself and as a means to the increased demand for electrical apparatus and supplies, and the co-operative planning and execution of various means and methods effective to this end.

Second—The establishment of co-operative commercial relations, both moral and financial, among the different electrical interests, from the manufacturer to the consumer, to the end that each may contribute in some measure toward bringing about the above results desired in common by all.

Double Aspect

The subject presents itself at once in two aspects:

First, as a theoretical principle in business development.

Second, as a practical, workable refinement in business organization.

Theoretical Aspect

Commercial co-operation, which we are all dealing with daily, consciously or unconsciously, in the development and management of individual business, is a thoroughly accepted principle and a recognized factor in increasing productive and distributing efficiency. It amounts to the recognition, by increasing numbers of men, of the fact that they can gain more individually by joining others in the prosecution of an enterprise than is possible in an equal degree by their segregated, conflicting, individual effort.

Within the memory of men present, business has passed consecutively through the periods of individualism, co-partnership, corporation, consolidation and association. This rapid transformation in method has been based upon, and is in proportion to, the recognition of broader grounds of common interest, on the basis of which, notwithstanding necessary differences, more effective means for their prosecution has been undertaken. Each advance has been in effect a refinement of the co-operative principle, and has justified itself fully through tremendous increase in the efficiency of production, with more questionable gains in the field of distribution.

Summed up in a paragraph, this development has amounted in some directions to the reasonable restraint of such competitive effort as tends to defeat the real objects of more efficient production and distribution, and in other directions to the stimulation of competitive effort in channels where the result is a gain to those ends.

It is to be observed that the field of manufacture or production has offered the widest play for enormous gains in the efficiency of production through specialization, co-ordination and co-operation. Selling and distribution, on the other hand, have not made any comparable gains in efficiency, although refinement and complexity of organization have been steadily progressing.

All this massing and complexity in the distributing field has incited competitive neutralizing resistance, so that progress as a whole has been made at a maximum expenditure of money and effort. Production has been subject to the advantageous working of the economic law of increasing returns, while distribution has been rather subject to the limitations of the economic law of diminishing returns.

If, therefore, within a given business, such as the electrical business, a plan of co-operative commercialism can be found which will develop under the economic law of increasing returns and escape from the wastefulness of unrestricted competitive distribution, which is subject to the economic law of diminishing returns—such a plan, I believe, must commend itself to your careful consideration. Even this hasty review of the development of commercial co-operation leads inevitably to the conclusion that, as at each step its application has increased real efficiency, so its further extension along lines dictated by its past evolution must carry corresponding gains.

So much for what one may choose to call the academic side of this proposition, which will be disposed of with the practical statement, with which we shall all agree, that a theoretical proposition is practical when it works.

Practical Aspect

The practical consideration of this question involves three propositions:

First—As to whether we have not now reached a stage of business development where a community of commercial interests actually exists of which we are not taking full advantage. Whether by further extension and adaptation of commercial co-operation among ourselves we can not more effectively and extensively influence the public to a larger and larger proportionate expenditure for electrical service of the eighteen billion dollars of wealth annually produced, rather than that it should be stored in savings banks, expended on automobiles, pianos, talking machines, and so forth, to say nothing of the appliances and devices that immediately compete with cheaper and inferior service for light, heat and power.

Second—If the existence of such a community of commercial interest can be so established, the second proposition involves the question as to whether practical plans can be presented to reap the advantages.

Third—Assuming the first two propositions, the third point involves the question as to whether per unit of money and effort expended on the plans they will yield a better return than it is now possible to secure.

As to the first proposition, we have passed in the electrical field through all the various stages of commercial development and have reached the period of associations, which exist in one form or another, city, state and national, in the central-station, contracting, jobbing and manufacturing fields.

An analysis of this broadening interest in co-operative or associated work is seen to rest upon an interdependence of commercial interests peculiarly strong.

First, this is noted as among the different services furnished for lighting, heating and power. The introduction of one service strongly disposes the users, as well as others, to the employment of the other two. The development of the lighting service immediately emphasizes the necessity for the development of the power and heating service, and upon the proper balance of the three largely hinges the future development of them all.

This community of interest seems clear when one considers that the electrical devices in which the public either are or can be interested are comparatively few in number for lighting, heating and power and relatively small in money value, yet upon their increased sale and use depend, first, the success of the central station and the contractors, and second, that of the jobber and the manufacturer.

The market for us all, therefore, whether reached directly or through and against one another, is in the end this great money-spending public, pre-occupied, incredulous and indifferent to the advantages of electrical service, so apparent to ourselves.

This question, then, of popularizing and educating the public to the freest possible use of electricity for light, heat and power is a vital, existing community of interests to us all, whether we manufacture, job, construct, or sell current. We are, in fact, joint sellers of the final service. Here is the edge of the commercial wedge which we owe it to ourselves and to one another, for the purest of commercial reasons, to drive home by the most effective methods for the expansion of the market, common in this degree to us all.

As to the second proposition, involving the question of practical plans, the following are the plans already formulated, which have been reviewed and favorably passed upon by your special committee of two years' standing as well as by committees of all the representative associations in the electrical field. Some of them have been put into operation, but many of them remain for the future, and are contingent upon widespread moral and financial co-operation, toward which we are aiming.

General Character of Plans

Broadly speaking, the plans as formulated aim at the creation and extension of the market along three lines.

First—Through creating the favorable conditions and providing the proper facilities for the most rapid and flexible interchange of the best commercial ideas and methods throughout the non-competing branches of the trade, the contractors and the central stations in particular.

Second—By bringing to the effective support of the non-competing branches of the trade the further united commercial stimulus and backing of the competing branches, the manufacturers and the jobbers.

Third—The massing of the combined selling strength of all branches of the common market, the public, through a national campaign of advertising and commercial publicity, exploiting the generic uses and advantages of electrical service, and by reaching in addition allied lines, such as architects, builders, contractors, real estate dealers, and so forth, with subsidiary campaigns and personal work.

The successful execution of the detailed plans will increasingly generate the disposition on the part of every one concerned to lend a hand, and this in turn would insure the further extension and prosecution of the movement, to which at the present time there appears to be no visible limit.

Detailed Plans

The detailed plans referred to are briefly outlined below:

Representatives in the Field

The commercial work of the executive officer, as is obvious, would be along the lines of general supervision of the activities of the association, presenting it and its work before national and state associations of central stations, jobbers and contractors, as well as before associations of manufacturers, aiming to increase interest in the work and to stimulate greater co-operation in making the work increasingly effective. His time would also be devoted to a considerable extent to increasing the membership of the association.

One representative would have immediate supervision of the detailed commercial work in the electrical field, spending the greater portion of his time in calling upon the lighting companies, jobbers and contractors in cities of 100,000 population and over, for the double purpose of giving and receiving information about the latest selling means and methods. He should be able to properly address the soliciting force of the companies visited, and to stir up increased enthusiasm and interest among them by reviewing the work of other companies and soliciting forces where the most progressive methods are followed and the best results secured.

If the suggestion already made is found to be practicable he can arrange for the interchange of expert solicitors from one company to another, which would doubtless be found to have a very stimulating effect upon the sales organization, and experience would undoubtedly suggest other lines of activity, of a similar character, which could be followed.

Where conditions would indicate the advisability, he would arrange to give a dinner to the leading commercial men connected with the central-station, jobbing and contracting interests, at which the association's work could be presented under most favorable circumstances. Much good to the business would doubtless result from such all-around interchange of ideas, experience and improvement of acquaintance.

Such general subjects as co-operative advertising of electrical service in the local newspapers by all interests effected, could be discussed, which seems to offer great opportunities in the few instances in which it has been tried.

He could use his good offices to further the interests of the co-operating advertising agencies where he believed their services would benefit the local interests.

He would make a point of furnishing the trade press with such commercial information secured in his work as would be stimulating to other companies for use in their new-business departments.

Finally, it would be his duty to turn in for permanent record a report of the general situation in each city, giving statement in detail as to the commercial conditions existing, so that in the course of time the progress made, as reflected by increased commercial activity, could be tangibly arrived at.

The work of a second representative would consist of the same lines of activity, except that it would be devoted to similar electrical interests in cities of from 10,000 to 100,000 population.

Under the direction of this representative would be three additional representatives, who would travel in cities of the population above noted.

All of these representatives, as well as every one connected with the association, would make a point of urging upon such central stations as are not represented in the state and national associations, the importance of membership and the advantages to be gained from it.

Twelve representatives would work along the same general lines as before described, except that their work would be in cities of a population of 10,000 and under. Some special conditions are often met with in these cities that do not appear in the others; namely, the question of the establishment of day circuits, as well as, frequently, the existence of systems of rates that are in themselves a hindrance to profitable business extension.

Referring to the question of day service in these cities, which is an important one, it may be noted that 67.78 per cent of the central stations in Michigan and 65.6 per cent of the central stations in Ohio do not maintain 24-hour service. This condition prevails, as already noted, largely in cities of 15,000 population and below. The president of the Michigan Electric Light Association, at its last meeting, stated that many such stations should be operating a 24-hour service, that there existed no sufficient reason why they should not. This offers, therefore, a very fertile field for effective work. The detailed statistics in reference to this situation in the states of Michigan and Ohio may be assumed to be typical of conditions existing in other states.

Provision is made in the plans for a corps of expert solicitors; one for power work, one for heating and one for lighting. Under the direction of the first representative, they would be employed in assisting such central stations or contractors as were found to desire it in starting an active commercial campaign. In this connection it has already been suggested by several of the smaller central stations that they would welcome an arrangement whereby they could secure the service of a solicitor for a part of his time. This suggests a line of work, which, if found practicable, could be indefinitely extended. It could also doubtless be placed upon a self-sustaining basis after some experience had been gained in its operation.

Representative Among Electrical Contractors

Provision is made for a representative who would devote his attention to the electrical contracting interests, co-operating with them along lines which might reasonably be expected to result in increased business. This work would be based upon an analysis of the commercial practices of the most progressive contractors, with the object of calling such methods as forcibly as possible to the attention of contractors generally.

He would also examine the conditions under which central stations and contractors are at present working together to the best advantage, with the object of making the basis of such relations known widely in both the central-station and contracting fields.

For the purpose of creating as much interest as possible in the association and its commercial work, the officers of the National Electrical Contractors' Association have offered the use of their trade paper for the establishment of a new-business department along the same general lines as those already maintained by the technical press, but naturally conformable to the special requirements of the contractors.

On this subject you will hear fully from Mr. James R. Strong, president of the contractors' association.

Representative Among Architects, Builders and Contractors

Provision is made for a representative whose work would consist of a broad and general study of the proposition of the wiring of property of all kinds, both old and new. He would make careful examination into the relations existing between architects, builders, contractors, real estate dealers and the electrical interests. He would make it a point of getting in touch with the national, state and city associations of the architects, builders and contractors, with the object of presenting before them papers dealing with the subject, and emphasizing the very great present and prospective utility of electrical service for light, heat and power.

This would involve a strong recommendation of the policy of freely specifying extra outlets—floors, baseboards and walls—as well as separate circuits for heating and miscellaneous electrical appliances, which is now not so generally done as would be in the interests of both the owner or occupant and the electrical interests, which would directly profit.

He would prepare, at the same time, articles for the trade press of these different trades, which would keep this subject before them in a live and instructive manner.

He would tabulate all the effective means and methods as now employed by central stations, contractors or others to secure the wiring of old and new construction work, and put this into the most effective and convenient shape for general distribution through the trade press and the special campaign of literature reaching these trades, which will be referred to later.

As he would be in touch with the latest practice in wiring and application of electrical devices, he would take charge of keeping the lists of applications of electric current up to date, and would issue them to the electrical trades and to the architects and contractors.

His work would put him in position to report to the Press Bureau any interesting or novel applications of electric service, which would be written up and sent to the trade papers, reaching the trade that would be interested.

Issuance of Commercial Literature to Electrical Trade

During the past year and a quarter a campaign of commercial literature has been issued to the central stations, jobbing, contracting and manufacturing trade in general, which has emphasized aggressive commercialism along the general lines of good service, persistent soliciting and convincing advertising. This campaign was keyed upon the practice of the most progressive and successful central stations, and its principal argument was based upon the general proposition that if $6.00 and $8.00, and even $12, *per capita* income for electrical service is proved in numerous instances to be possible where these aggressive commercial methods are employed, and 50 cents to $2.50 appear to be the varying results in cities where they are not employed, aggressive commercialism along the lines exploited in this campaign and in the trade papers would appear to be the missing link.

The aim would be, briefly, for the future to carry this part of the work along in such a manner as not to lose any of its cumulative effect.

A campaign of commercial literature will be issued to the electrical contractors and dealers, dealing with the subject of the extension of the business from their standpoint. This would be worked out along the same general lines as the previous campaign in the central-station field, but adapted to special conditions. This campaign would closely dovetail with the work of the special representative, as before described.

Issuance of Commercial Literature to Allied Trades

For the purpose of supplementing the work of the special representatives among the architects, builders, contractors and real estate dealers, a bi-monthly campaign of special advertising would be issued to 5000 architects, and, in addition, to the leading builders, contractors and real estate firms, which would present forcibly the very great present and prospective utility of electrical service for light, heat and power.

Work in this field will be conceded to be of a most fundamental nature. It is obvious that this line of work is important to all electrical interests, as a building correctly wired is almost a sure user of electrical service. On the other hand, thousands of possible customers are at the present time lost on account of properties not having been wired during the last ten years. This loss will be all the more keenly felt and appreciated as increased efficiency develops in electrical appliances which will make them more and more practicable for people in more moderate circumstances, as appears to be the present outlook in the lighting field.

In the current issue of *Sweet's Indexed Catalogue of Building Construction,* which reaches a list of 10,000 architects, builders, contractors, and so forth, seven pages have been purchased in which a comprehensive table of the applications of electric current are tabulated by lines of business under subdivisions of light, heat and power. The introductory pages emphasize to these allied lines of trade the great importance of familiarizing their clients with the many efficient and useful applications now available.

Co-operating Advertising Agencies

Certain advertising agencies have entered the electrical field in friendly co-operation with the association. Central stations, contractors, and others, have been offered through this medium the opportunity of securing a highly specialized advertising service at a schedule of rates that otherwise would not have been possible. The evidence submitted indicates clearly that their services have been effective and profitable along business extension lines. Of this, however, you will hear more fully from Mr. Lawrence Manning.

School of Scientific Salesmanship

Underlying successful salesmanship lies a body of fundamental laws relating thereto. Business in its increasing specialization is fast coming to be reduced to a science. We now have the School of Scientific Salesmanship. Arrangements have been made whereby this association will co-operate with one of these schools in bringing to the attention of the commercial men in the electrical business the benefits to be derived from this source.

This subject will be fully presented by Mr. J. D. Kenyon, of Chicago.

The Technical Press

The technical press is deserving of the very greatest credit for the manner in which it has endorsed this entire co-operative commercial campaign through the opening up of new-business departments in the several papers. There can be no doubt that they have exerted a powerful influence in bringing about the results that appear to have been accomplished.

The association would aim to work as closely as possible with the technical press in every way, as it constitutes an effective medium for reaching the distributing trade along these lines.

It has been suggested that for the present commercial supplements should be issued, dealing with particular phases of the business-getting problem, and doubtless other uses will be found for their columns, on the basis of which the association will find it profitable to spend a reasonable amount of money with them.

You will hear from another speaker, who will review the activity of the electrical trade papers along commercial lines, and who will likewise suggest a line of more active co-operation with them which can not help but result in benefit to all concerned.

Special Inducements for Commercial Work

You are familiar with the thousand dollars in prizes which was offered by the association for the best papers on the subject of the Organization and Conduct of a New-Business Department. These have been very widely distributed through the electrical trade papers, as well as by publication in pamphlet form. I think there can be no reasonable doubt that they have had a very marked stimulating effect.

Additional prizes, aggregating some $2,600, for the preparation of an electrical solicitors' handbook have been offered, which I will only briefly touch upon, as the subject will be treated quite fully by Mr. R. S. Hale in a separate paper. There is, at the present time, a very great demand for electrical solicitors, doubtless in consequence of the greatly increased interest and activity in the commercial field, and it is hoped, first, that this handbook will serve to stimulate the present soliciting forces in competing for the prizes, and, second, that the final product will be of permanent value in the way of stimulating and instructing solicitors, relieving managers in many cases from the details of their instruction.

Among the medium-sized and smaller stations, particularly, the solicitors are drawn from the young men in the place, who frequently have no electrical experience. This book should be of very great assistance in these cases in rapidly whipping them into more effective salesmen. It should also be of material value to managers of the smaller central stations, where soliciting is done by the manager or employees having other duties to attend to.

National Commercial Press Bureau

I believe that this field is a most fertile one for effective work in popularizing electrical service. It is obviously one of the broadest lines of work that can be undertaken, inasmuch as every one in the business would be directly or indirectly benefited.

A full treatment of the subject would require this entire paper. We will, therefore, simply say that its practicability in the electrical field has been actually demonstrated, as instanced in the case cited below, as well as in other directions.

The present Washington convention is being covered in this manner, and you may be sure that the entire country will hear of its doings in a way that will be of advantage to the National Electric Light Association and to the business as a whole.

I extract below from an address by Mr. Ivy L. Lee, a specialist in this field, which was presented before a meeting of a joint committee of the electrical trades:

"Now there can be no question that electricity is one of the most interesting subjects in the world. Its application to our daily life is constantly becoming more widespread. This is an electrical age. The attention the world has recently given to the Cooper Hewitt light, the Marconi wireless telegraph and the Roentgen rays, shows with what eagerness the public watches for every development of this current. Electricity will always have a large 'news value.' Even such well-known objects as the telephone and telegraph are constantly featured in the day's news. The interest in electricity is perennial. That is because it is transforming our modern life. The man interested has only to describe some 'novelty' of this marvelous transformation and it immediately becomes 'news.'

"To make the matter practical, Mr. Crouse asked me to demonstrate directly the possibilities of this kind of news service in behalf of electricity. As an instance of what might be done, a few weeks ago I sent throughout the country a description of the home of Mr. Hillman. You will find one of the results in the Cleveland *Plain Dealer.* That article was printed all over the country. The Washington *Post* used it in a very ingenious way. It published the article with a large display on one page, and on the page opposite, the business manager printed an advertisement of the local central station. This up-to-date, far-sighted manager evidently 'tipped off' the central station about the plans of the news page, so the manufacturer of current ordered the very extensive display advertisement, telling the public where they could get all the electrical devices mentioned in the news article. That was, to me, as striking an example as I ever saw of 'commercial publicity' supplementing the work of regular advertising. For, in the last analysis, the two things are very different and should aid one another.

"I am satisfied that if you were to establish through this new association what Mr. Crouse calls a 'National Electrical Press Bureau,' you could secure steadily a great deal of news space in the papers throughout the country. Your *Electrical News* should tell of the novelties of the time, and of novel uses of old objects, showing in a very practical way, though not too pointedly, how any reader could make use of the same things himself.

"This would be publicity of the most valuable kind. The local central stations could follow it up directly. If conducted properly, the net results should be extremely satisfactory to the editors, the readers and the managers of the papers, as well as to those of you who are engaged in an industry which represents the latest practical benefits of science and progress."

National Campaign of Advertising in Magazines and Periodicals

This is likewise a line of activity that can not be gone into effectively within the limits of time available to us. The proposition was effectively presented at the last March meeting by a national expert in this field, Mr. E. E. Calkins.

The following is extracted from his remarks at that time:

"Conscious co-operation comes when all the people interested in producing electricity and producing the various instruments, machines, equipment, lamps, motors, heating devices, and the like, required to use electricity, get together and say: 'The more people there are who want electricity in some form or in all of its forms, the better for us; therefore, we will get together and spend money in educating the people to recognize electricity as the greatest modern helpmeet of business and domestic life.' "

This expert, in discussing magazine advertising as a general proposition, expressed the opinion that collective co-operative advertising by all the individual firms and corporations of a given industry was fundamentally and essentially sound. The advantages of the use and service of devices are exploited on a generic basis, disregarding the individual claims and differences of the manufacturers, avoiding in this way unnecessary waste of competitive advertising in popularizing the service. In the long run the business resulting would by the law of averages reach the different interests concerned through the various distributing channels established in reasonable proportion to the expenditures incurred.

On certain of the plans as above outlined, $55,000 has already been spent, and fully an equal amount by the trade papers and advertising agencies and others whose co-operation has been secured and induced. During the last 90 days, $75,000 has been underwritten, and for the completed plans as drawn an ultimate annual expenditure of $370,000 is involved.

This covers a hasty review of the plans as formulated. Suggestions for effective work in many other directions have been considered, which can be fitted into the general plans as the association develops.

Results

As to the results secured, a summary was made in December, 1906, which included reports from 934 central stations, each one of which had taken up (many for the first time) that year some one of the following commercial activities:

Organized new-business department
Put out or added solicitors
Began direct-by-mail advertising
Began newspaper advertising
Increased their advertising appropriation
Opened up display and demonstration rooms
Hung out their own electric sign

This amounted in the aggregate for 1906 to an expenditure of $871,347.50, and with the reasonable assumption that it has continued for the five months of 1907 it would now aggregate $1,234,408.95. Allowing 45 cents as a liberal estimate of the cost of securing a 16-cp equivalent of new or added business, this would result in 2,743,131 16-cp equivalents, or 137,156.55 kilowatts.

Assuming that this business was added to the peak (or would eventually come to be), it would have created, at $100 per kilowatt, a demand for electrical and other apparatus and supplies aggregating $13,715,655, which would directly accrue to the benefit of the manufacturers, jobbers and contractors, and aggregate sales of electric current for the central stations in the amount of $6,857,827.50.

Indicated by the barometer of incandescent-lamp demand, it may be said that this co-operative movement was started May 12, 1905, when the incandescent-lamp manufacturers appropriated the initial $10,000 for its execution. The gain in lamp sales for the country at large was 5 per cent in 1904 over 1903; 8 per cent in 1905 over 1904; 20 per cent in 1906 over 1905, and thus far this year more than 25 per cent over the corresponding period of 1906. With due regard for the prosperous times that we have enjoyed, here is a result that rightfully must challenge your attention.

It has not been possible to get a complete tabulation of the results, some of which have just been indicated, and this should, therefore, be taken as an offset in the interpretation of the results as being traceable in a large degree to the co-operative movement. Viewed as a whole, the expenditures incurred in relation to the business that has been developed from the standpoint of the manufacturers alone is but 0.004 per cent in relation to the added business. If the result be cut in two, it amounts to 0.008 per cent, or if one-fourth, to 0.016 per cent.

Prominent men in all branches of the electrical business freely concede that these results are largely traceable to this co-operative movement and on the basis of the above percentages must more than make good the third contention—that per unit of time and money expended it demonstrates itself to be a remarkably efficient system of creating and extending the business from the standpoint of all branches of the trade.

I am neither desirous nor presumptuous enough to credit myself individually with more than a modest hand in bringing this about, for I think you must perceive that it has rather been the resultant effect of the idea of commercial co-operation here presented working through considerable numbers of other men.

When this proposition becomes understood on its merits for what it is really worth, it will be discovered that we are simply making a practical application of the tremendous force of co-operative constructive work in the commercial field which has already so largely been perfected in production.

Special Points in the Organization

The co-operative association through which it is proposed to prosecute and extend this work differs essentially from the prevailing association idea, in that it is directly modeled on the corporation, with salaried officers and employees devoting their entire time to it, with a board of directors of 27 from all branches of the trade; similarly an executive committee of seven and with co-operating committees from electrical associations of all kinds.

It amounts, in fact, to a corporation whose stockholders and members would comprise individuals, firms, corporations, and so forth, directly or indirectly interested in manufacturing, jobbing, contracting and in the sale of electric current. The tremendous commercial force that could be wielded by such an organization as it gradually developed must be, I think, apparent.

Conclusion

In conclusion, we have, I believe, disclosed in this co-operative movement the thread of an existing but unrecognized principle of common commercial interests running throughout the entire electrical business, which, with increasing interest and co-operation already manifest, can be woven by us all into a commercial cable of a strength and efficiency not hitherto attained or attainable along any other lines essentially different.

As in the field of science and invention, as applied to production, the effort of the electrical and mechanical engineer is directed to overcoming the inertia loss and waste of inanimate matter, so it seems to me it must be the serious duty and business of the commercial engineers to turn their attention to the reduction of the corresponding loss, waste and friction of unrestricted competitive distribution.

The task, as it has been mapped out, is too large for any one or group of us to undertake. It can only be accomplished through multiplying our effective commercial power through co-operation. Its success, therefore, is contingent upon its making a successful appeal to large numbers in all branches of the business, so that they will be willing to share equally in the work and proportionately in the results.

Electricity itself, applied to communication and transportation in the annihilation of time and distance, has been, and is, the real instrument of all closer commercial co-operation and association upon which modern business development is based. I submit to you, therefore, that we, of all men, who are its immediate devotees, should be the first to recognize the essential unity existing in our own business, display our willingness to work the problem out together and secure finally the tremendous business benefits which surely must follow.

J. Robert Crouse

CONSTITUTION AND BY-LAWS, CO-OPERATIVE ELECTRICAL DEVELOPMENT ASSOCIATION

Certificate of Incorporation

We, the undersigned, all being persons of full age and citizens of the United States, and at least one a resident of the State of New York, desiring to form a corporation pursuant to the provisions of the Membership Corporations Law, being Chapter 559 of the Laws of 1895 of the State of New York, and the acts amendatory thereof, do hereby make, sign, acknowledge and file this certificate for that purpose.

First: The name of this corporation is "Co-operative Electrical Development Association."

Second: The objects and purposes for which this corporation is formed are:

To promote and increase the use by the public of electric current for light, heat and power, as an end in itself and as a means for increasing the demand for apparatus and supplies, and to promote and facilitate a co-operative planning and execution of various means and methods effective to this end;

To establish co-operative relations, both moral and financial, among the different electrical interests, from manufacturer to consumer, to the end that each may contribute in some measure toward bringing about the aforesaid results desired by all; and to bring about the mutual co-operation, benefit and protection of its members;

To purchase, acquire, own, sell, let or otherwise obtain or dispose of such real or personal property in the State of New York or elsewhere as may be useful or requisite for the effecting of the aforesaid objects and not contrary to law;

To mortgage or pledge any property, real or personal, which may have been acquired, to secure the payment of any bonds or other indebtedness which it may be necessary or proper to issue or incur, which may not be contrary to law.

Provided, however, the corporation is not to make a profit, nor to make or declare dividends.

Third: The territory within which the operations of this corporation are to be principally conducted, is the limits of the United States of America, its territories and possessions, Canada and Mexico, but it shall also have power to conduct its operations in part in other countries, if this shall be deemed necessary to accomplish the objects and purposes of its organization.

Fourth: The principal office of the corporation shall be located in the Borough of Manhattan, City, County and State of New York.

Fifth: The duration of this corporation shall be perpetual.

Sixth: The number of directors is to be twenty-seven, or such number not less than three, and not exceeding twenty-seven, as may be elected, pursuant to the provisions of the by-laws. The number of directors to hold office until the first annual meeting of the corporation shall be nine.

Seventh: The names and post-office addresses of the directors to hold office until the first annual meeting of the corporation are as follows:

Names.	Post-office Addresses.

IN WITNESS WHEREOF, we have made, signed and acknowledged this certificate in duplicate, this .... day of............ one thousand nine hundred and seven.

ARTICLE I

Members

1. MEMBERSHIP: Any individual, firm, corporation or association engaged or interested in the manufacture, construction or sale of electrical or other apparatus or supplies, necessary to the production, distribution or utilization of electric current for light, heat or power, or engaged in the manufacture or sale of electric current for any of these purposes may become a member of this Association by expressing a desire so to do and by manifesting this desire by an application in writing to the Secretary, and signing the membership contract.

2. ANNUAL MEETING: A meeting of the members shall be held annually at the principal office of the Association in New York at 11.30 o'clock in the forenoon on the second Tuesday of May, for the purpose of electing directors, and for the transaction of any other business authorized or required to be transacted by the members. In case such second Tuesday shall be a legal holiday, the meeting shall be held on the next succeeding day which is not a legal holiday.

Notice of the annual meeting shall be mailed at least ten days prior to the meeting to each member at the address last furnished by him to the Association, provided he shall have furnished such address.

3. Special Meeting: Special meetings of the members may be called at any time in the discretion of the Board of Directors and shall be held at the principal office of the Association in New York.

Notice of such special meeting and of the object or objects thereof shall be mailed to each stockholder in like manner as notice of an annual meeting.

4. Quorum: One-third of the members in good standing present in person or by proxy shall constitute a quorum at any meeting for all purposes, including the election of Directors.

5. Voting: At any annual or special meeting, each member shall have one vote for each $100 or fraction thereof which he has subscribed since the last annual meeting, for the purposes of the Association; provided, however, that if three members of the Board of Directors are officers or employees of any one firm or corporation, no vote cast for any other officer or employee of that firm or corporation shall be valid, and if on a single ballot more than three officers or employees of a single firm or corporation are elected to positions on the Board of Directors, the vote cast for the one last nominated shall be considered void.

ARTICLE II

Board of Directors

1. Number: The Board of Directors to be elected at the time of organizing this Association shall consist of nine members. If it shall be deemed to be for the best interests of the Association, by a majority of such Board of Directors, the size of the Board may be enlarged by the appointment by such Board of Directors, of one or more other members, except that the Board of Directors shall not have the power to increase its number beyond twenty-seven.

2. Term of Office: Each Director, whether elected at an annual meeting or appointed by the Board of Directors pursuant to Section 1 of this Article, shall serve for one year or until his successor shall have been duly elected at an annual meeting.

3. VACANCIES: In case of any vacancies occurring in the Board of Directors, through death, resignation, disqualification or other cause,' the remaining Directors by affirmative vote of a majority of their number whether constituting a quorum or not, may elect a successor to hold office for the unexpired portion of the term of the Director whose place shall be vacant, and until his successor shall have been duly elected and qualified.

4. MEETINGS: The Board of Directors may hold its meetings and have one or more offices and keep the books of the Association, at such place or places in the State of New York, or outside of the State of New York, as it may from time to time determine.

Regular meetings for the transaction of necessary business shall be held on the second Wednesdays of May and November respectively. If such day is a legal holiday, the meeting shall be held on the next succeeding day which is not a legal holiday.

Special meetings may be called by the President or any three Directors. Each Director shall furnish to the Secretary an address to which notices of special meetings may be sent. Notice of the time and place of each special meeting shall be sent by mail to each Director who has furnished such address, at least two days prior to the meeting.

A majority of the Board of Directors shall constitute a quorum for the transaction of business.

5. POWERS: The management of all the affairs of the Association shall be entrusted to the Board of Directors except as otherwise provided by law or by these by-laws.

6. EXECUTIVE COMMITTEE: The Directors shall elect from their number an Executive Committee to consist of seven members and shall designate one of such seven members to be the Chairman of the Committee; provided, however, that any single firm or corporation represented in the membership shall have not more than one of its officers or employees a member of such Executive Committee. The members of the Committee and the Chairman thereof shall serve for a period. of one year, or until the election and qualification of a new Board of Directors.

During the intervals between the meetings of the Board of Directors the Executive Committee shall possess and may exercise all the powers of the Board of Directors in all cases in which specific directions shall not have been given by the Board of Directors.

The Executive Committee shall hold monthly meetings at such times and places as shall best suit the convenience of a majority of its members.

A majority of the Executive Committee shall constitute a quorum for the transaction of business.

7. FINANCE COMMITTEE: The Directors shall elect or appoint from their number a Finance Committee to consist of three members, or, at their option, engage public accountants, whose duty it shall be at least once a year to thoroughly examine the records and accounts of the Association, and report to the Board the results of their examination.

8. BY-LAWS: The Board of Directors shall have power to enact new and amend existing by-laws, as hereinafter provided, and to fix penalties for their violation.

ARTICLE III

Officers

1. ELECTION OR APPOINTMENT: The Board of Directors shall elect from their number a President and Vice-President; they shall also appoint a Secretary-Treasurer and General Manager, who need not be members of the Board.

2. TERM OF OFFICE AND COMPENSATION: The officers so elected or appointed shall hold office for one year or until their successors are duly elected and have qualified, and their compensation shall be fixed by the Board of Directors.

3. DUTIES OF OFFICERS: The President shall preside at all meetings of the Board of Directors and members and shall in general perform the duties usually incident to the office.

The Vice-President shall perform all duties of the President during the absence of the latter.

The Secretary-Treasurer shall have charge of the records, files, reports, accounts, subscription fund, and other properties of the Association. He shall have custody of all the funds and securities of the Association which may have come into his hands and shall keep full and accurate accounts of all moneys received and paid by him on account of the Association. He shall keep the minutes of all meetings of the members, of the Board and of the Executive Committee, and he shall attend to the giving and serving of all notices. He shall also perform such further duties as shall be delegated to him by the General Manager.

The General Manager shall have the general management and supervision of the work of the Association subject to the direction of the Executive Committee and of the Board of Directors. He shall submit, at the monthly meetings of the Executive Committee and at the semi-annual meetings of the Board of Directors, a report on progress and plans, which report may be transmitted to the members. He shall have authority to enter into alliances and contracts for services of various kinds which in his judgment will tend to advance the interests of the Association; provided, however, that he shall not enter into any contract for personal or other services requiring an expenditure in excess of $1,000 except upon the express authorization of the Executive Committee manifested in writing by a majority of its members, if such action is to be taken between the times of the regular meetings of the Committee, or by vote, duly recorded on the minutes of such Committee, at a regular meeting; and provided further that no expenditure or obligation of any kind shall be voluntarily incurred when there are not sufficient funds to meet the same in the treasury or due on subscriptions over and above the reserve fund hereinafter provided for. No funds shall be expended or obligations of any kind whatever voluntarily incurred without the approval and countersignature of the General Manager. It shall further be the duty of the General Manager to issue to the members quarterly reports of the progress and plans of the Association, such reports to be issued as of the dates of the termination of the regular quarters of the fiscal year, to wit, March 31, June 30, September 30 and December 31.

ARTICLE IV

Membership Subscriptions

The funds necessary to carry out the purposes of this Association shall be subscribed by the members thereof, the terms and conditions of such subscriptions to be subject to the direction and approval of the Board of Directors or of the Executive Committee.

In order that the purposes of the Association may be carried out, it is estimated that it will be necessary to have subscriptions at the rate of 1-10 of 1 per cent on the gross amount of sales by the members, of electric current, electrical or other apparatus and supplies used directly or indirectly in connection with public service corporations furnishing electric light, heat and power, and to isolated plants, but sales of traction apparatus and other sales not connected with the above fields shall not be included.

It is the intention that the conditions applying to such subscriptions, as determined by the Board of Directors or the Executive Committee, shall be in general conformity with the foregoing estimate of requirements of the Association for funds.

ARTICLE V

Expulsion

Any officer, director, employee, or member, who in the judgment of the Board of Directors has been guilty of a violation of the rules and regulations of the Association, or of acting in a manner prejudicial to its interests may be expelled from the Association by a majority vote of the Board of Directors, thereby losing all rights and privileges of membership or employment; provided, however, that any such person shall be furnished with a copy of the charges against him at least ten days before action is taken, and be permitted to appear either in person or by counsel in his defense.

ARTICLE VI

Reserve Fund

From the funds received, an amount not exceeding 10 per cent of such funds received in any one year, may be set aside by a majority vote of the Board of Directors, as a Special Reserve or contingent fund, which fund, however, shall not be permitted to accumulate beyond an amount equal to the average yearly expenditures of the Association for the three preceding years. This reserve fund shall be invested in a savings account or in such securities as may be authorized by the Board of Directors, and the whole or any portion thereof may, upon a majority vote of the Board of Directors, be applied to carrying on the work of the Association during any one year.

ARTICLE VII

These By-Laws may be altered or amended as follows:

Any proposition to alter, amend or repeal any existing By-Law must be presented in writing to any meeting of the Board of Directors at any time before adjournment; such proposition must be seconded by at least three Directors; it shall be twice read, and if after the second reading, it is approved by a majority vote of the Board, it shall take effect as an alteration or repeal as the case may be; provided, however, that no such amendment or alteration shall affect any action pending at the time of its adoption. Any additional By-Law not in conflict with any existing provision of the By-Laws or Certificate of Incorporation may be adopted at any regular meeting of the Board of Directors, upon being presented in writing, being duly seconded, twice read and approved by a majority vote of the Board of Directors.

Chairman Freeman: Mr. J. F. Gilchrist, of Chicago, will read the report of the National Electric Light Association's "Co-operative" Committee.

Mr. Gilchrist read the following report:

REPORT OF COMMITTEE TO ASSIST IN THE FURTHER DEVELOPMENT AND PROSECUTION OF THE PLANS OF THE CO-OPERATIVE ELECTRICAL DEVELOPMENT ASSOCIATION

Mr. President and Members of the National Electric Light Association:

The plan and scope of the Co-operative Electrical Development Association have been presented at the two preceding conventions, at Denver and at Atlantic City, by Mr. J. Robert Crouse, the originator and guiding spirit of the movement.

You have just heard from Mr. Crouse the progress that has been made since our last convention and the outlook for the immediate future.

Your special committee appointed at Denver in 1905 reported at Atlantic City last year in hearty support of the movement. The following paragraph is copied from such report:

"The financial obligation of the work as at present formulated rests upon the manufacturers. The central station interests have been asked to bear no part of the expense. In this, of course, the manufacturers are working not altogether unselfishly, but with enlightened self-interest. As the work develops, similar consideration of self-interest may lead the central stations to feel that it warrants financial support in proportion to the benefits derived. In the meantime your committee believes that the movement should receive the unqualified moral support of the members of the National Electric Light Association. The proposed co-operative association is an organization having for its object the common good, and its efforts should be received in the broad-minded spirit in which they are put forth."

Your present committee, a majority of whom were not members of last year's committee, has devoted several entire days to a critical analysis of the movement, in consultation with Mr. Crouse and also with many representative manufacturers and others whose knowledge and experience were valuable. Each member of the committee has attended every meeting, and all are unanimous in the belief that the time has come for the members of this association to give more than "moral support" to the plan; in fact, to participate with the manufacturers on an equal percentage basis of expense and a correspondingly equal control over the direction of the movement.

The members of your committee believe that through the wise expenditure of the money which would be available to the association through such joint participation, results along the lines of commercial development would be achieved which would repay many times the expenditure, and in which every subscriber would receive his full share of benefit.

Of course, the movement, to be effective, would be so conducted that companies withholding their support would be likely to enjoy the benefits of the movement equally with those who would bear the cost; but a general movement of such character, if inaugurated and supported at first by the broad-minded and more progressive manufacturing and illuminating companies, would within reasonable time command the financial support of practically all.

In general, this movement would constitute a clearing-house for ideas and methods and an effective publicity bureau for the popularization of the use of electricity for all practical purposes. Through its organization and the wide scope of its work it would accomplish results, the country over, which could not be brought about through other than an extensive co-operative movement.

The proposed membership subscription is approximately 0.1 per cent of revenue from the sale of electrical or other related apparatus or electric current. Most of our member companies are to-day spending from two per cent to five per cent of their gross income in publicity work, combining advertising and solicitation, for obtaining new business. What would be required, therefore, from a participating company would be that a small portion of its expenditure for obtaining new business be subscribed to the Co-operative Association, in the belief that such proportion could be more advantageously expended through such movement, and with better results than by using such additional sum wholly in the local territory.

For the above reasons, your committee has arranged that the proposed by-laws of the Co-operative Electrical Development Association shall admit illuminating companies to equal membership rights with manufacturers and others upon the same terms. The proposed form of organization, in the opinion of your committee, will guarantee conservative and wise direction of the movement for the common good and absolutely free of control by any selfish interests.

Your committee recommends the hearty endorsement of the co-operative movement as now outlined and proposed, and suggests the active participation in the organization and direction of the association by the member companies.

Respectfully submitted,

Committee
W. W. FREEMAN, Chairman,
JOHN F. GILCHRIST,
R. S. HALE,
J. E. MONTAGUE,
F. M. TAIT.

The following papers, relating to the Commercial Field and to Questions of Policy, were then read: *Possibilities of Commercial Development,* Mr. Henry L. Doherty, New York; *New Business—How to Get It—How to Keep It,* Mr. Frank M. Tait, Dayton, Ohio; *New-Business Results Demonstrated in Cities of All Sizes,* Mr. J. E. Montague, Niagara Falls, N. Y.; *Sales Policy of a Combination Gas and Electric Company,* Mr. F. A. Willard, Rochester, N. Y.; *Co-operation of the Electrical Trade Papers in Business-Getting,* Mr. F. W. Loomis, Savannah, Ga., and editors of *Electrical World, Electrical Review, Western Electrician* and *Illuminating Engineer.*

POSSIBILITIES OF COMMERCIAL DEVELOPMENT

With your permission, I will introduce this subject by quoting certain extracts from my opening address to the National Electric Light Association in Cincinnati, May, 1902. At that time I said:

"There seems to be a prevailing belief that this association should be strictly a technical society, but I am confident that if we devoted ourselves entirely to technical matters it would be detrimental to the central-station industry, and we should be covering a field that should be covered by other associations, and neglecting a field of work which would not then be covered by any association. . . . It is clearly the province of this association to cover the field of central-station work, whether it be the solution of how best to transform heat to power, or how best to acquire business. . . . We have not yet reached the commercial age, and I predict that within five years the members of our association will almost lose sight of engineering matters in their eagerness to increase their sales. Our earnings through economy of operation have well-defined limits, but the possibilities of increasing our earnings by developing our market have a much wider range. . . . I believe our business to-day might be considered as of a retail nature compared with what it will be a few years hence."

It is now five years since the above was written, and the prophecy made at that time has not been wholly realized, for as yet we have not reached the climax of our eagerness for the acquisition of additional business. I also want to admit that my prophecy would have been even less true had it not been for the earnest, persistent and intelligent work of Mr. Crouse. The work carried on by the association of which he is a leading spirit has done much to arouse the central-station men to the possibilities of the development of their market, and I think the industry owes him some evidence of appreciation for his work, and can well afford to co-operate with and support him more actively in the future than it has done in the past.

We have already reached the commercial age. Each day the commercial end of our business assumes greater and greater importance. The aggressive work being done by many central stations in the country has created a new standard of lighting, and while it is possible for the other central stations to do nothing and still reap some benefit from the work of others, it is now possible for a small expenditure of money and effort to bring splendid returns in the field of development of business.

It is by concerted effort of all central stations that the greatest development can be secured. Some jealousies have recently sprung up between the engineering branch of the business and the commercial branch of the business, but I see no reason for this, as each has its proper sphere, and I see no reason why the engineer can not take up new-business work, if he chooses to do so, and feel that with the same qualifications he is better equipped to realize success than the man lacking in the special technical knowledge of the business.

When the men who exploited our large national expositions wanted to make the whole world wonder and the tongues of the whole world wag, they did not depend upon the area of their exposition grounds nor the magnitude of their buildings, but depended almost entirely on the lavish use of light. Light is synonymous with optimism. Artificial light attracts everything animate, from bugs to men. The most famous feature of New York city to-day is the lavish lighting of upper Broadway.

The thousands of visitors who have been attracted to the national expositions by the lavish use of light can be attracted to any city that uses light with equal profusion. For every dollar of benefit secured by the national expositions ten dollars of benefit will be secured to the city that can make its lighting brilliant to a degree that will attract universal attention and wonder.

In another public address, made some years ago, I predicted that the progressive merchant in the future would display as lavish lighting as was then characteristic of the national industrial expositions. This, I think, has proved nearly true, and I think it is safe to say that no one has yet reached the point where further lavishness in lighting will not pay. The lavish displays already made have proved profitable, and as each merchant has endeavored to excel the other the additional lighting has been relatively even more profitable.

We used to talk about the point of saturation, meaning that time when we should have sold all the light and power that could be sold in a given city. If there is such a thing as the saturation limit we have not yet found it. I can say truthfully that the longer we carry on the development of work, the more easily additional business is acquired and the more business there is still in sight. We are now taking on business in some of the stations with which I am connected at a greater ratio each year than the entire business of any central station amounted to when I first became interested in the subject of development of the market.

If time would permit, I should be glad to discuss the various branches of possible further development, including sign, window and outline lighting; also higher standards of interior illumination, decorative effects, and so forth, as well as the heating and power branches of the business, but there is so much to be said on each branch of this work that one ordinary convention would not suffice to cover all the profitable discussion which might be had.

I have referred to my former predictions regarding the development of market in a manner that has left me open to the charge of immodesty—with enough circumstantial evidence to carry conviction—but I have done this with a purpose, as I wished to assert that we do not yet appreciate the value of this feature of our work. If you will admit that I have heretofore been partially right, I believe this method of presenting my subject may at least arouse sufficient interest to warrant each of my hearers in giving this subject serious thought.

Henry L. Doherty

NEW BUSINESS

HOW TO GET IT—HOW TO KEEP IT

The problem of obtaining the largest possible amount of profitable new business each year with the minimum expenditure for same is, or should be, the vital question with every central station. Many stations have not awakened from their lethargy and are doing nothing to hurry along the growth of their business; then, there are others who have made or are making spasmodic and irregular efforts along the new business line.

It is a fact that every lighting company must have new business of the right kind, if the various companies are to be a success; and if we want new business, how are we to get it, and when we get it how are we going to keep it and enlarge it?

You are all more or less familiar with the card-index system and prospect list as ordinarily prepared for a given locality when a central-station management decides to go after new business and do it properly and aggressively. The proper type of solicitor to go out after the new business and produce satisfactory results is rather a hard man to find, and it usually means that young men of promise must be trained for the positions. This branch of the electrical business offers an excellent field for bright, active young men, and it is surprising that more young men do not realize the excellent opening in this field of electrical effort, and qualify themselves for it.

Every central station should provide a library containing a number of the best books on the various branches of the business, and also have on file the various electrical magazines and papers, to enable the young men in the various working departments of the company to qualify themselves theoretically as well as practically for the position of an expert on the new-business force. The solicitors can also make good use of this library and, as a result, will become better new-business solicitors. The most aggressive central stations in the country to-day complain of the difficulty of procuring men who can continually bring in the profitable new business required. The salary commanded is high and the training excellent, with a wide field always before the expert solicitor.

The solicitors of new business should fill out a proper record of their daily operations, and a correct summary of all calls made, new business obtained, expenses, and so forth, should be kept, and carefully tabulated for prompt attention and reference. These tabulated summaries enable the company to follow the efforts made and the results accomplished.

The number of men required will depend upon the size of the city and how aggressively the company intends to go after the new business. Many of the larger companies have highly specialized corps with chiefs, and so forth, while the smaller companies of necessity depend upon the superintendent for the greater portion of the special work, with possibly one or two solicitors to push along the work.

Lectures and talks should be given regularly to the new-business force by authorities on the best ways and means of obtaining profitable business.

To fortify the solicitor in his daily rounds for new business, it is essential that the company do all in its power to have all complaints—real or fancied—reported by consumers or observed by the company's employees, corrected promptly and satisfactorily. Good service and courteous treatment should always be the watchword, and reasonable rates for the various kinds of service should be the rule. Do not leave anything undone that you can do to enable the company to retain the good-will and confidence of the general public. You must have this confidence to obtain and keep the maximum business.

The use of the local newspapers should be undertaken with cuts and well-written advertisements properly displayed and frequently changed. This is a part of the new-business effort that should be carefully looked after, as considerable money may be wasted if the subject is not intelligently handled. The newspapers are also likely to be friendly, especially if your company's attitude is right, the service good, and the rates normal.

The use of short, crisp, well-written individual letters setting forth the particular branch of business you are endeavoring to advance, should be mailed at regular intervals to a selected list of prospects, and in alternate mailings reply postal cards addressed and stamped for return should be enclosed. These mailings may be as frequent as the conditions warrant. and the replies received will be very gratifying if the letters have been properly framed, and the solicitor is thus given an excellent opening to present his case.

All envelopes leaving the company's office for local addresses should contain a folder or pamphlet descriptive of an economical electrical appliance for the use of current, and, as many of the manufacturing companies supply these pamphlets free, and with the lighting company's name printed thereon, it may be done with practically no expense.

No opportunity should be lost sight of to keep the progressiveness of the central station before the public, for the live community likes to feel that its business interests are wideawake, and the dormant locality should be aroused by the aggressive lighting company whose name should always stand for progress. The lighting company can do a great deal to dispel the lethargy by boulevard and public square lighting, sign and billboard lighting, outline, window and decorative lighting, and so forth.

Every electric light company should install one or more attractive electric signs, properly located to be effective, and burn same every night; billboards can likewise be used, with trough reflectors to illuminate same. These methods, while primarily intended to advertise the company's business, effectively point the way to others for a similar purpose and provide new avenues for the use of electric current.

The matter of outline and window lighting should be vigorously canvassed and much business of this kind, as well as sign and billboard business, may be obtained by arranging to furnish the current for a flat sum per lamp of stated candle-power per year, and arranging to have the signs, and so forth, switched on at dusk from April 1 to September 1, and six p. m. the rest of the year; switching off the signs, outline lighting, and so forth, at a determined hour nightly. In these propositions it is well to allow sufficient time in the rate charged to provide for the signs and outline lighting running until midnight for the two weeks prior to Christmas. This scheme keeps the load off the extreme peak and will be found to yield profitable results, and to help the appearance of the locality by night.

All construction work, tool boxes, wagons, and so forth, should carry appropriate emblems, banners, or other devices, indicative of the company's activity and calling attention to the use of electric current. It is this constant pounding of ELECTRICITY into the minds of the public that sooner or later has its reward in more new business.

One company, to the writer's knowledge, has a standing offer to furnish free incandescent lighting to any church or charitable institution holding a lawn fête or festival, provided the installation of the wiring, sockets, and so forth, is donated by a local contractor. This proposition is made on the theory that electric light will be found to be so much better for the purpose, that the effect will be to work back into the church, home, store or business.

Every progressive lighting company should have a display room of some kind, and it should be kept in first-class and attractive shape; not as many lighting offices and so-called display rooms are usually found—unclean, dusty, full of cobwebs and half-broken and disabled apologies for modern electrical appliances and apparatus. The display room, if possible, should occupy the front part of the main office, with the desks, cages, and so forth, of the working office force arranged across the room and well to the rear of the office. Advantage should then be taken of the opportunity for display and demonstration by installing, in first-class and proper working order, samples of the various appliances, apparatus and lighting effects that are known to be economical and successful for using current. Competent attendants should always be in charge of the display room. This arrangement compels consumers and their friends, on their way to pay bills, enter complaints, and so forth, to absorb, almost against their will, as it were, the fact that electric current is a necessity for comfort at home, as well as a necessity in business. The correct type of display room, brilliantly lighted outside as well as inside, will be an attractive point for people in all walks of life, drawn by the unusual brilliancy which should be its chief feature at night, and the new-business solicitors will find the display department a very potent factor for them to bring prospects for the final arguments, demonstrations and closing of contracts.

It would seem that every electric lighting company in this country should be alive to its own opportunities and go out after the business that may be had in every community, but it is a deplorable fact that a very large number—by far the great majority—are doing practically nothing in the way of hustling for new business, increased gross and net receipts, and the general feeling of satisfaction that comes with all of this. Why should any manager or superintendent be satisfied to let well enough alone? Why should not these comatose companies contemplate what has been done by other companies similarly situated, and many of them very disadvantageously located?

The following figures will serve to illustrate what may be done when the right spirit is aroused.

In a town of 10,000 inhabitants, in the Far West, a company decided about a year ago to take up the aggressive new-business scheme, and it reports that for the first two weeks in April of this year it has secured the following new business:

Wired one hundred old houses
Twenty-five lamp signs sold and installed

Two hundred and fifty flat-irons sold
Eight coffee percolators installed
One hundred and twenty horse-power in motors installed

It estimates that this new business will return an annual gross revenue of $10,000 and that $1,200 was spent to secure it in personal solicitation, newspaper advertising, circular letters, special propositions and advertising in the shape of booklets, pamphlets, and so forth.

Another example is found in an Ohio village with a population of 1400. This company states that its capitalization is $15,000, all paid in, and no bonds. All of the additional investment has been made out of the earnings, besides which it has paid 33 per cent in dividends in seven years.

The gross and net earnings by years are given as follows:

1899..........	Gross earnings,	$2,800;	net earnings,	.....
1900..........	" "	3,800;	" "	$1,500
1901..........	" "	4,300;	" "	1,700
1902..........	" "	5,400;	" "	4,900
1903..........	" "	6,500;	" "	2,100
1904..........	" "	7,500;	" "	2,300
1905..........	" "	8,300;	" "	2,800
1906..........	" "	9,000;	" "	3,100
1907..........	" " (est.)	11,500;	" "	4,500

It would seem that these examples, which represent the average size central station in 78 per cent of the total central stations in the United States, together with the reports that will be heard to-day on new business demonstrated in cities of all sizes, should be evidence enough to cause every plant in this class, as well as other companies, to immediately embrace the long-neglected opportunity in their respective localities. If there is any central station belonging to this association that has neglected the chance for excellent results from an aggressive new-business campaign, let it get to work at once.

It has been found that the new-business department of any company, properly exploited, is a very great factor in popularizing the company.

Many plants have probably held back, fearful that the expense of going after the new business vigorously would be prohibitive and would leave the company in a worse condition than before it started the campaign. It is a comparatively simple matter to estimate in advance what results and expense in connection therewith may be expected. It is accepted by the central-station men who have been through the experience in many different ways, that from 2.5 to 5 per cent of the yearly gross receipts is a proper amount to expend in an energetic effort for new business. It is generally conceded that, on the average, the percentage of net gain in profits, where new-business methods have been taken on aggressively, tends to at least equal the percentage of gain in gross sales and frequently the net profit is double, or more, the percentage of increase in gross income.

New-business departments properly manned and thoroughly aggressive can produce load curves on the station output that will show that while the peak may be increased 10 to 15 per cent, the average load off the peak is raised 30 to 50 per cent, and this is a simple proposition to work out, provided the new-business men go after the revenue-producing and economical kind of business for the central station.

The new-business department should be provided with weekly load curves of the output of the station and the subsequent week's curves superimposed, so that each month may be compared with previous months, and so forth, and the effect of the new business watched.

The introduction of domestic appliances should be pushed vigorously and they should be sold at or near cost and on liberal terms, allowing the consumer to return same if not satisfied, at the end of a 30 or 60-day trial. When a solicitor has sold an article to an old or a new consumer, it should be the policy of the company to have the enlarged old consumer or the new consumer visited by some one competent to learn if everything is working out well and as represented. This will go a long way toward cementing the proper feeling of the consumer toward the company, and makes the matter of securing further business from the same source very simple.

No connected load along the mains should be considered too small to take on, although proper rates should be charged for the kind of service rendered. It is a matter of record that porch and cellar lights often lead to the complete equipment of residences for the full use of electricity. Consistent and persistent effort should be put forth to prove to power users that electric power is the power they need, and keen, special effort is often needed to prove the point. The average power user figures in dollars' profit per month and year, and the installation of temporary motor equipment to demonstrate the proposition frequently compels the sale of same and furnishes a satisfied power consumer, who tells his friends.

After the business has been obtained, keep everlastingly after the consumers and be sure their service is satisfactory and that they are getting what they were promised, and a little more, and hold out to them further and larger uses of the current.

Those companies that have not taken up the aggressive new-business policy will do well to revolve the whole scheme in their minds, and take the data and experiences that will be produced at to-day's meeting, fit it to their locality, and see if they can not profitably spend a small percentage of their gross receipts in order to get new business that will show a net gain equal to, and perhaps double or treble, what was economically spent for soliciting the business.

Those companies that have not yet installed new-business departments or taken up the matter aggressively, those that have taken it up in a half-hearted, dreary manner, those that have a pet theory that their respective methods of obtaining new business are the best, should keep before their mind's eye the excellent results obtained by the little village in Ohio of 1400 people where progressive new-business-getting of the most pronounced type has produced a revenue of $8.50 *per capita* and still increasing, and this in the fact of competition from a good supply of natural gas in the village, at 25 cents per one thousand cubic feet. Any central-station man who has made it a point to learn the *per capita* yearly income that is obtained to-day by the various large companies, as well as by many average and small companies, will thoroughly appreciate what $8.50 *per capita* means.

Think of it—small companies, medium companies, large companies—$8.50 per year for every man, woman and child, and then let us go home from this convention and decide that we will all take a new hold on the commercial end of the various companies and strive to emulate our small contemporary who accomplished these wonderful results by simply keeping after it! Let us go after the new business energetically, and when we obtain it, carefully husband it and enlarge it, and use every possible addition to our gross receipts as a stepping-stone for more and better results. Any company can do it, anywhere. Analyze your local conditions and then go after it. Be aggressive commercially. It pays.

Frank M. Tait

NEW-BUSINESS RESULTS DEMONSTRATED IN CITIES OF ALL SIZES

This question of new business and more business is, briefly, as has been and will be developed in the various papers and discussions, the resultant of the forces, of the men, management, money and methods, *plus enthusiasm* directed to it. All of these, except possibly the money element, are variable, which our very presence at this convention assumes can be and are influenced in the direction of increased efficiency by comparison of views and interchange of commercial knowledge.

A review of the commercial development of central-station fields during the last few years, and particularly the last two years, makes it very apparent that this subject must command constantly-increasing attention from all electrical interests.

In the face of the fact that $2.50 *per capita* income from the sale of electric current was the average according to the last census, the fact develops that where central stations take up seriously and aggressively the new-business methods under discussion, the *per capita* sales have been and can be increased to from $5.00 to $8.50, and even $12 *per capita*, in cities of all sizes and conditions.

While technical and engineering developments have necessarily dominated the electrical business largely in its earlier development, the standardization of generating and distributing practice has reached a point where it seems that the purely business and business-getting branch is to yield for the future proportionately larger returns from the increased attention given it.

The results of the commercial departments of many central stations indicate the following interesting facts:

First—That the *per capita* incomes in such stations rapidly pass the average of those where live active interest is not taken in the commercial development.

Second—That expenditures of from 3 to 5 per cent, and even more, of gross income on business extension along proper lines is fully justified by the results. This percentage of expenditures, it will be noted, is very small as contrasted with more competitive lines of business.

Third—That the load curve is very materially improved, and in consequence the ratio of gross income to operating expense.

Fourth—That central stations which have operated these commercial departments for two or three years, or even longer, do not, as at first might be expected, reach the point of business saturation, but continue to maintain the rate of increase through educating the public to higher standards of service and through the introduction of new devices and appliances.

Fifth—That aggressive commercial departments are the most important factors in the cultivation of improved relations with the public and have in numerous instances been worth to companies all they cost from this standpoint alone. We should soon reach—if, indeed, we have not already reached—the point where the commercial engineer in his work of creating and extending the business will be entitled to take equal rank and importance with the electrical and mechanical engineer in the perfection of his work of producing, generating and distributing apparatus and the reduction of current cost. It would seem that the mechanical and electrical engineer should welcome the advent of the commercial engineer, since the efforts of the latter are directed to extending the field of operation of the former and toward introducing more largely the comforts, conveniences and benefits of the entire art.

In the light of the results that have been reviewed, I would urge upon the central stations that this subject be given a very careful and an increased amount of attention.

Appended you will find some interesting commercial statistics which I should like to see made a feature of all of our future commercial programmes.

NEW-BUSINESS RESULTS DEMONSTRATED

In City of 1350 Population

Items	Year Ending May 1, 1905	Year Ending May 1, 1906	Year Ending May 1, 1907	Per Cent Increase
Number of customers			415	
Gross income	$6,200.00	$8,700.00	$11,500.00	33.4
Gross income *per capita*.....			$8.50	
Total number 16-cp 50-watt equivalents connected ...			5000	
Gross income per kilowatt of maximum station capacity			$48.00	

Approximate sales expense per 16-cp 50-watt of added business: We spent to secure the above results for year ending May 1, 1906, on line and plant extensions, soliciting and advertising expenses of all kinds, about $4,000.

Actual sales expense per unit is small, but a figure can not be given.

Our rates: Highest, 29 cents per kilowatt for 7.5 hours' maximum demand service or less per month. Lowest, 4.5 cents per kilowatt for 180 hours' maximum demand per month; all excess over this figure, 2 cents per kilowatt.

We employ no solicitors, depending on our own force.

Our load-curve sheets for the period named above have been destroyed, but our output May 1, 1906, was less than on May 8, 1905, owing to the installation of meters.

Remarks: Aside from ample maintenance and a low dividend we have devoted our entire income to the extension of our business and the necessary capacity to meet the new services.

In City of 5000 Population

Items	Year Ending 1906	Year Ending 1907	Per Cent Increase
Number of customers	402	567	41.05
Gross income	$21,521.00	$31,540.14	46.38
Gross income *per capita*	$5.66	$6.30	11.31
Total number 16-cp 50-watt equivalents connected			
Gross income per kilowatt of maximum station capacity	$53.80	$78.76	46.39
Approximate sales expense per cp 50-watt of added business			

1. Our rates are: Light, 10 cents per kilowatt; power, 8 cents per kilowatt; cooking, 5 cents per kilowatt.
2. We employ solicitors or their equivalent.
3. We do direct-by-mail advertising.
4. We advertise in local newspapers (very little).
5. We maintain display and demonstration-room.
6. We operate our own electric sign.
7. Remarks: Prior to 1903 there was no systematic effort made to secure business; in fact, business was on a decline at this time. The results obtained from our cooking units are proving very satisfactory indeed.

In City of 15,000 Population

Items	Year Ending 1905	Year Ending 1906	Per Cent Increase
Number of customers	705	872	23.7
Gross income	$59,000.00	$64,000.00	8.5
Gross income *per capita*	$3.93	$4.27	8.6
Total number 16-cp 50-watt equivalents connected	26,000	30,000	15.4
Gross income per kilowatt of maximum station capacity	$73.75	$80.00	8.5
Approximate sales expense per 16-cp 50-watt of added business	$0.35	$0.35	....

1. Our rates are 10 cents light, 5 cents power. Discounts for quantity and cash.
2. We employ one solicitor or his equivalent; since January 1, 1907, two.
3. We do direct-by-mail advertising (very little).
4. We advertise in local newspapers.
5. We maintain display and demonstration-room.
6. We operate our own electric sign.
7. Remarks: See *Electrical Review,* April 13, 1907, New-Business Department, for details.

IN CITY OF 20,000 POPULATION

Items	Year Ending January 1, 1906	Year Ending January 1, 1907	Per Cent Increase
Number of customers	1000	1300	30.0
Gross income *per capita*............	$2.39	$2.98	24.75
Total number 16-cp 50-watt equivalents connected	26,250	31,215	19.0
Gross income per kilowatt of maximum station capacity	$115.00	$119.00	0.03½
Approximate sales expense per 16-cp 50-watt of added business.......	......	$0.37	....

1. Our rates are: Sliding scale, 12 cents to 6 cents. Gross income for year ending January 1, 1907, fell off on account of reduction in rates on May 1, 1906.
2. We employ two solicitors or their equivalent.
3. We do direct-by-mail advertising.
4. We advertise in local newspapers.
5. We maintain display and demonstration-room.
6. We operate our own electric sign.
7. We attach load curves for the two above periods.
8. Remarks: We are increasing in gross earnings for first three months this year 20 per cent. With us it is a question purely of educating the public. We expend 5 per cent for new business.

IN CITY OF 30,000 POPULATION

It was not possible to get in the detailed data from this plant on acount of lack of time; but the following, quoted from their letter, will be found interesting:

> Rates for lighting, 12 cents to 6 cents per kilowatt-hour, depending on the consumption, the 12-cent rate applying to residences and very small business consumers, the stores, offices and larger consumers sliding from 10 cents down to 6 cents. Flat rate for arc lamps of $5.00, $6.00 and $7.50 per month, depending upon the number of hours in service. Power rates from 8 cents to very small consumers to 3 cents in cases of very large consumers.

After outlining a newspaper campaign, conducted for the purpose of setting the company in its true light before the public, the letter goes on to say:

> This campaign was conducted for three months, and at the end of that time we started an extensive follow-up campaign. This was divided into three sections; one consisted of our residence customers, in connection with which we endeavor to interest them in other household uses of electricity; another was a list of prospective residence customers, and still another consisted practically of all of the business concerns in the city. To these we are sending advertising matter, advocating better methods of lighting, store-window lighting and electric signs. The follow-up campaign consists of two monthly mailings—a letter on the first of each month and a booklet or folder the 15th of the month.
>
> As a result of this work we have been able to bring about a better feeling on the part of the public toward the company, and a better understanding of its objects and aims, and at the same time our business has grown very rapidly.
>
> One specific result has been that our lighting and power load has grown to the extent that we have been compelled to build a new power

station, the plans for which have just been gotten out. Work on this new power station will be begun in the very near future, and its cost will be about $250,000.

As a point of interest during the past three weeks we have conducted, in a large dry-goods store, a demonstration of the household uses of electricity. This consists of an extensive display of cooking, heating and other household devices, such as laundry irons, laundry machinery, sewing-machine motors, electric radiators, complete cooking outfits and many other household appliances and devices. Some one article has been demonstrated each day, and the demonstration has created a good deal of interest and is still being continued.

IN CITY OF 35,000 POPULATION

Items	December 31, 1905	December 31, 1906	Per Cent Increase
Number of customers	1026	1291	26
Gross income	$87,000	$104,000	20
16-cp equivalents connected	25,450	31,953	26
Gross income per kilowatt of station capacity	......	$75	..

1. Our rates are as per attached schedule.
2. We employ two solicitors or their equivalent.
3. Direct-by-mail advertising.
4. Local newspaper advertising.
5. Display and demonstration-room.

Remarks: On policy, and so forth—make rates as low as possible; provide capital necessary to equip new customers and do not ask them to take any chances. Keep the above facts before the public and particularly that portion of it which may be classed as prospects. We place the percentage of gross income to be devoted to new-business getting at about 2.5 per cent.

IN CITY OF 35,000 POPULATION

Items	Year Ending June 30, 1905	Year Ending June 30, 1906	Per Cent Increase
Number of customers	473	513	8
Gross income	$90,017.00	$107,590.00	20
Gross income per customer	$190.31	$209.72	10
Gross income *per capita*	$2.57	$3.07	19
Total number 16-cp 50-watt equivalents connected	35.000	42,000	20
Gross income per kilowatt of maximum station capacity	$45.00	$53.80	20
Approximate sales expense per 16-cp 50-watt of added business	Have no means of telling.		

1. Our rates are: 20 cents maximum, 10 cents minimum, with sliding scale, for incandescent and arc lighting; 10 cents maximum and 0.018 cent minimum, with sliding scale, for electric power.
2. We employ no solicitors.
3. We do no direct-by-mail advertising.
4. We do not advertise in local newspapers.
5. We maintain display and demonstration-room.
6. We operate our own electric sign.
7. We attach load curves for the two above periods.
8. Remarks: As a gas and electric lighting company it has been the policy of the company not to push or develop electric lighting. All our energies, therefore, have been confined to the increasing of our electric power business, which has been obtained through personal solicitation.

Our business is increasing now very rapidly, and we have approximately 2000 horse-power in motors connected and on order at this time. The business has been obtained by continuous personal solicitation, with the assertion that electric power is the best, cheapest and most economical power to use, backed up by the data shown on the enclosed power card.

The ground here has not been covered as thoroughly as it might have been, owing to the fact that no regular solicitor is employed; no attempt is being made to increase the electric lighting, this field being left to the gas department.

I think that with a competent solicitor, provided with all the facts and data which we possess, and with catchy local newspaper advertising and a continuous distribution of attractive advertising matter through the mails, a great deal more business could have been gotten than we now have, although we are well satisfied with our increase in the power department, considering the facilities with which we have had to work.

The enclosed curves are a pretty good demonstration of the results that can be obtained by persistent, continuous and intelligent soliciting campaign. One side of this sheet shows the individual curves of the street series arc-lighting system, in blue, the three-phase, 550-volt power system in green, and the single-phase commercial arc and individual lighting, in red. On the opposite side of the sheet is the combined total station curve, made up from the three systems.

While a comparison between the lighting curve for 1903 and 1907 shows a comparatively small increase by reason of our policy, it will be observed that the three-phase power curve shows an increase of 600 per cent.

IN CITY OF 40,000 POPULATION

Items	Year Ending February 10, 1906	Year Ending February 9, 1907	Per Cent Increase
Number of customers	700	860	23
Gross income	$85,000.00	$100,000.00	18
Gross income *per capita*	$2.12	$2.50	18
Total number 16-cp 50-watt equivalents connected	38,560	45,000	17
Gross income per kilowatt of maximum station capacity	$8.50	$10.00	17
Approximate sales expense per 16-cp 50-watt of added business	$93.50	$55.50	Decrease 40

1. Our rates are: 14 cents first 2 kilowatts per 16-cp equivalent. Converted, additional at 6 cents.
2. We employ two solicitors or their equivalent.
3. We do direct-by-mail advertising.
4. We advertise in local newspapers.
5. We maintain display and demonstration-room.
6. We operate our own electric sign.
7. We attach load curves for the two above periods.
8. Remarks: Have 2000-kw plant but find that railway and light and power are the same, therefore assume 1000 kilowatts for light and power.

In going over some old figures I find that in 1904 the company had a gain of 62 customers with the equivalent of 2445 16-cp. In 1905 there was a gain of 63 customers with the equivalent of 2705 16-cp. In 1906 there was a gain of 160 customers, equivalent on the connected load to 6500 16-cp.

We feel during the year 1907 that the increase in customers will be 25 per cent above the increase for the past year. Our most ambitious effort in soliciting and advertising was made during the year 1906.

We would say that a company in a town of from 10,000 to 75,000 people could spend profitably from 2.5 to 4 per cent of its gross receipts.

You will note the marked decrease in the cost of securing new business during the year 1906 as compared with that of the year before. We feel that we have now reached the maximum of expense, which on our present receipts is equivalent to about 3.5 per cent of our gross revenue. With the increase in gross receipts during the year 1907 our expenses for soliciting and advertising should be in the neighborhood of about 2.5 per cent.

IN CITY OF 80,000 POPULATION

Items	Year Ending May 1, 1906	Year Ending May 1, 1907	Per Cent Increase
Number of customers	About 2500	About 3000	20
Gross income	$381,400.00	$435,000.00	14
Gross income *per capita*	$5.00	$5.44	9
Total number 16-cp 50-watt equivalents connected	80,000	102,000	27
Gross income per kilowatt of maximum station capacity	$44.87	$51.17	14
Approximate sales expense per 16-cp 50-watt of added business	......	$0.12	..

1. Our rates are: 15 cents per kilowatt and 8 cents on Wright demand system. Special rates to large users.
2. We employ two solicitors or their equivalents.
3. We do direct-by-mail advertising.
4. We advertise in local newspapers.
5. We maintain display and demonstration-room.
6. We operate our own electric sign.
7. We attach load curves for the two above periods.
8. Remarks: Answering your inquiry of recent date regarding new-business results demonstrated in cities of this size, will say that we started the campaign last summer, offering to connect up a house, providing six outlets with fixtures and the outside connection from the street, for $30. This brought in a large number of new customers, and at the expiration of the time given for the taking up of this proposition, we followed up the ground gained by sending out solicitors to get other customers to do their own wiring. In connection with the solicitors' work we have been using the monthly advertising matter furnished by the ——— company, and have been able to get a number of people to take our service in this manner.

We are sending you under separate cover some samples of the better class of advertising matter which we have used to good advantage; we think these samples may illustrate our point better than a description of them in a letter. We believe the answers on blank which we are enclosing cover the rest of the points you desired to know about.

On the whole, we are very well satisfied with our new-business campaign, and are convinced that it pays to make special inducements to induce people to take our service. After we persuade them we make a special point of delivering the goods, and our representatives always follow up the customer to see that he is satisfied in every particular.

IN CITY OF 100,000 POPULATION

Items	Year Ending January 1, 1905	Year Ending January 1, 1907	Per Cent Increase
Number of customers	600	2412	302.0
Gross income	$137,924.65	$225,000.00	66.1
Gross income *per capita*	$1.37	$2.25	64.2
Total number 16-cp 50-watt equivalents connected	50,000	125,000	150.0
Gross income per kilowatt of maximum station capacity	$30.65	$45.00	46.8
Approximate sales expense per 16-cp 50-watt of added business	none	$0.21	....

1. Our rates are: 12 cents gross to 5 3-10 cents gross for light, 10 per cent discount; 7 cents gross to 3 3-10 cents gross for power, 10 per cent discount.
2. We employ eight solicitors or their equivalent.
3. We do direct-by-mail advertising.
4. We advertise in local newspapers.
5. We maintain display and demonstration-room.
6. We operate five of our own electric signs.
7. We attach load curves for the two above periods.
8. Remarks: We follow the most advanced ideas in the new-business field—personal solicitation, newspaper and bulletin work, demonstration, and so forth, and hope in the next year or so to bring our city up to where it should be. Think 5 per cent of gross receipts can safely be devoted to new-business getting.

IN CITY OF 278,000 POPULATION

Items	Year Ending 1905	Year Ending 1906	Per Cent Increase
Number of customers	5878	6964	0.185
Gross income	$842,598.65	$994,339.44	0.180
Gross income *per capita*	$3.02	$3.57	0.182
Total number 16-cp 50-watt equivalents connected	361,625	440,775	0.155
Gross income per kilowatt of maximum station capacity	$120.37	$142.05	0.180
Approximate sales expense per 16-cp 50-watt of added business	$0.1602	$0.209	0.304

1. Our rates are: For lighting, 10 cents per kilowatt for the first 120 hours' use per month of the total installation, excess at 5 cents per kilowatt; motor, 10 cents for kilowatt for the first 30 hours' use per month of the total installation, excess at 5 cents per kilowatt.
2. We employ eight solicitors or their equivalent.
3. We do direct-by-mail advertising.
4. We advertise in local newspapers.
6. We operate our own electric sign.
5. We maintain display and demonstration-room.
7. We attach load curves for the two above periods.
8. Remarks: The load diagrams which we have include both railway and lighting and can not be used in comparison with the above data.

IN CITY OF 300,000 POPULATION

Items	Year Ending June 1, 1905	Year Ending June 1, 1906	Per Cent Increase
Number of customers	4630	6839	47.7
Gross income	$542,377.00	$702,744.00	29.5
Total number 16-cp 50-watt equivalents connected	265,145	380,832	43.6
Approximate sales expense per 16-cp 50-watt of added business	......	$0.39	....

1. Our rates are: 10 cents per kilowatt to 3 cents per kilowatt, varying according to connected load, current consumption and burning hours.
2. We employ fifteen solicitors or their equivalent.
3. We do direct-by-mail advertising (two pieces monthly).
4. We advertise in local newspapers.
5. We maintain display and demonstration-room.
6. We operate our own electric sign.
7. We attach load curves for the two above periods.
8. Remarks: The approximate sales expense given above is, however, hardly fair to the company, for the reason that the soliciting expense covers the entire cost of the contract department. This includes the handling of all transfer business and many other details necessary to properly attend to the wants of the consumers. We do not believe that more than half of the contract expense of this company is incurred in actually securing new business.

    In regard to our commercial policy, will say that we keep up an active solicitation for new business at all times. The town is divided into districts and a competent man placed in charge of each. He is held responsible for the business getting in his district, and is kept up to the mark all the time. The new-business policy of our company may be described as one which operates upon the maximum of everlastingly hustling until the business comes in. Our fiscal year, which will end June 1, 1907, will show a continuation in the percentage of growth, as indicated for the preceding year.

IN CITY OF 1,425,000 POPULATION

Items	Year Ending December 31, 1905	Year Ending December 31, 1906	Per Cent Increase
Number of customers	7403	10,192	37.5
Gross income	$2,542,733.21	$2,848,822.26	12.0
Gross income *per capita*	$1.85	$2.00	10.8
Total number 16-cp 50-watt equivalents connected	937,715	1,167,595	25.0
Gross income per kilowatt of maximum station capacity	$169.51	$93.63	44.8
Approximate sales expenses per 16cp 50-watt of added business gross	$0.112	$0.169	15.0
net	$0.323	$0.341	5.5

1. Our rates are: 12 cents per kilowatt-hour *used* for lighting; special rates when used in quantity. 10 cents per kilowatt-hour for power, with sliding scale of discounts up to 50 per cent for monthly bills of over 3750 kilowatt-hours.
2. We employ twenty solicitors or their equivalents.
3. We do direct-by-mail advertising.
4. We advertise in local newspapers.
5. We maintain display and demonstration-room.
6. We operate our own electric sign.
7. We attach load curves for the two above periods.
8. Remarks: Increase in income has been affected by rate reductions, the percentage of increase of output being much larger than the percentage of increase in gross income.

J. E. Montague

Questions of Policy

SALES POLICY OF A COMBINATION GAS AND ELECTRIC COMPANY

I have assumed that the above subject refers entirely to the dealings of a combination gas and electric company with the public.

First, in order to insure the successful operation of any company there must be a well-defined policy, or system, governing the corporation as a whole, likewise each department must have its individual policy and system, and all departments with their systems must work together smoothly as an intricate, well-oiled piece of machinery. A corporation that attempts to do business without thus organizing its forces and carefully outlining its policy can be likened to a ship at sea without a rudder. In calm weather it will float on, probably in the right direction, but as soon as the wind begins to rise the ship will drift about at the mercy of the gale and sooner or later come to grief in the breakers.

Mapping out the policy of a gas and electric corporation is, I am aware, a stupendous subject in itself, and one in which I shall not attempt to go into detail, but there is one phase of it that is pertinent to the subject we are discussing, and that is the attitude the company assumes toward the public. The good will and friendship of the public is essential to the success of any gas and electric corporation; therefore the local situation should be carefully studied and any obstacles that stand in the way of obtaining the favor of the people should be removed, or overcome so far as possible and consistent with the rights of the company.

In this paper, however, we have particular reference to the policy and system of the commercial department and its relations to the public. In order to obtain the best results it appears to me that the policy of a combination gas and electric company should be laid out on about the following lines:

Policy

Give the consumer the most for his money. Carefully consider his interests, and in all cases install the service that will give him the most satisfactory results, economy and practicability considered. Take the time and trouble to demonstrate to him, by figures so far as possible, the advantages of the installation you recommend. This policy will in most cases produce the following results: All short-hour business will go to gas; all long-hour business to electricity. By following this plan you will not only succeed in giving the consumer the most satisfactory service, but will also operate your gas and electric stations under the most economical conditions. And to assist you in carrying out this plan your electric rates should be made up on a load-factor basis. This for the reason that the capacity of an electric plant is based on one-minute peak and the capacity of a gas plant is based on 24-hour business. The expediency of this policy is further demonstrated by the tabulation given on page 29 of this paper, showing the cost of plant and distribution system based on maximum peak and average daily load conditions, as compared with the cost of a gas plant on the same conditions.

Selling Appliances—Electric

It is my opinion that the managers of gas and electric companies are becoming convinced that in order to get the best results appliances should be sold and installed by the company. In this way the company is able to regulate the selling price, keeping before the public the appliances best adapted to its needs, and at the same time protecting the consumer against possible unfair treatment at the hands of local contractors.

Electrical Contractors

In every town of 25,000 inhabitants or over there are electrical contractors whose business it is to sell and install electrical appliances, from the sale of which they expect to make a living profit, and as this class of people are good agents for the electrical corporation, I believe it is wise to protect them in so far as it is consistent with the policy and operation of the company. In order to do this the selling price of appliances should be fixed by the company, so far as possible, at what would be considered a fair profit to the electrical contractor. Of course the prices obtainable vary in different localities and with the individuality of each company, and on appliances which it is necessary for the corporation to handle I do not think you can fix a sales policy that will cover all.

Wiring Department

The company should also maintain a wiring department, which so far as possible should be operated so as to produce the same margin of profit as appliances. This policy, if followed out carefully, will interfere very little with the business of electrical contractors. There are, of course, exceptions to every rule, and one of the exceptions to the above, in regard to maintaining margin of profit, would be in the case of a manufacturer who is sceptical about the economy of operating electric motors in place of a steam plant. In such cases a special analysis of the existing conditions should be made and, if they warrant it, install electric motors at the lowest possible figure or, if necessary, at cost, on a guarantee that the factory could be operated at a monthly amount not to exceed a stipulated sum.

An appliance which the corporation can not afford to leave to the contractor is the electric iron. This, as you know, can be installed in the consumer's residence at practically no cost to the company, other than the small expense incident to handling and installing, provided a sale price is put on the iron. I have always maintained that this appliance could be distributed free among resident consumers with a profit to the company. Take, for example, a six-pound iron, consuming 500 watts, operating in a residence. This iron will be in service from four to ten hours weekly, or an average of seven hours, equivalent to 14 kilowatt-hours per month, and amounting at a 10-cent rate to $1.40 per month. As this load would come on during the day and not touch the lighting peak, there would be no additional operating or station expense, provided station is operated by water-power. In case of a station operated by steam the only account that would be affected would be coal, which amounts to approximately half a cent per kilowatt-hour. Therefore, in the case of a water-power station the electric iron business would be clear profit, or the installation would pay for itself in two months. In the case of a steam-power plant there would be an operating cost of half a cent per kilowatt-hour, or 7 cents per month, which also means the iron would practically pay for itself in the same length of time. From these figures you can readily see that any electric company could afford to give the irons away. On the other hand, you can put them out at $3.50 each (and I think could install just as many as you would if you gave them away) and the price allows the contractor a slight profit, although as a usual thing they do not care to handle such appliances on so small a margin.

To be consistent with the policy outlined, electrical heating appliances, in the present state of the art, should not be installed by a combination company, and the only excuse for putting out the electric iron is the convenience it gives the consumer and the artificial demand created through the medium of the newspapers and advertising.

If we consider the consumer's interests and give him the most for his money on heating appliances, we should recommend gas-consuming appliances. This is clearly shown by the following:

Gas at $1.00 per thousand feet
Electricity at 10 cents per kilowatt-hour
1 kilowatt-hour = 3410 B. t. u's = 10 cents
100 feet gas = 65,000 B. t. u's = 10 cents

The tabulation shows a ratio of 19 to 1 in favor of gas.

Gas Appliances

On gas-consuming appliances we find a different situation. The method of handling and pushing the sale of gas-consuming appliances depends to a great extent upon existing conditions. In a town where the residences and existing factories have not been educated to the use of gas the company must first create a demand for gas through the medium of the papers, the plumbers, contractors, and its own representatives and solicitors. The matter of creating a demand through the plumbers and contractors requires tactful methods and must be carefully handled in order to obtain results. The contractors and plumbers should be educated to understand that the company is *creating a demand for gas,* incidental to which they are getting a large percentage of piping work, which they otherwise would not be able to obtain.

During this campaign appliances must be sold by the company at cost, or in most cases slightly below. This, you understand, covers only such appliances as would not compete with electricity.

After all this has been accomplished, the only new business obtainable will be among the new buildings, and so forth, and at this time the price of appliances should be increased so as to create such proportional margin of profit for the benefit of dealers as can be derived from the sale of electrical appliances. The plumbers and dealers will thus be encouraged to promote their sale.

Lighting

The question of lighting by combination gas and electric companies has, I think, been solved by most companies along the lines mentioned—that is, as far as possible, all long-hour business to electric lighting; all short-hour business to gas. This policy is determined by the load-factor that the lighting load in question would place upon the station. The cost per kilowatt-hour to the company for current would be in inverse proportion to the load-factor, which would be based on 24 hours' use; while for gas lighting, the load that is thrown on the work depends upon the load-factor only if an additional pressure is required at the works to force distribution during the lighting period. In case this additional expense is necessary it will amount to very little, and, so far as affecting the cost of operation, is practically nothing.

The following tabulation shows the relative cost to the company of the two systems:

Electrical Plant—Maximum Peak

Distribution system	$200 per kilowatt
Plant	150 " "

Maximum peak, 100 per cent above the average day load

If it were not necessary to provide for this peak the total cost of plant and distribution systems would be reduced one-half. The kilowatt-hour represented by the peak is less than two per cent of the average day load.

Operating Expense—Electric Plant

Generating expense	25	per cent of total expense
Distribution expense	36	" " " " "
General expense	39	" " " " "
	100	per cent

Gas Plant

Cost of gas in holder....	54	per cent of total expense
" " " distribution .	9.14	" " " " "
General expense	36.86	" " " " "
	100	per cent

Special Lighting—Residence

In the better class of residences in any town or city I would recommend soliciting both gas and electric lighting. You will find that people of this class favor the use of gas for fuel and special appliances. They will also use combination fixtures throughout the residences. By so doing you will get a larger revenue from each than you would if you allowed but one service in a house. To verify this I have selected in our own town (Rochester, N. Y., 200,000) several streets at random throughout the better section. On these streets I have selected at random 32 consumers and find their bills run as follows:

During the year 1904 these residences used gas service only and their monthly gas bill averaged $4.00 each.

During 1905 an electric service was installed and in most cases combination fixtures were put in, and the average monthly gas bill during 1905 and 1906 amounted to $2.89, while the average electric bill for the same consumers during same period amounted to $3.84, making the total average revenue from each consumer $6.73, or an increased revenue of 68 per cent.

Lamp Improvements

The possibility of turning more long-hour business over to the electric end has been made easier by recent improvements in electric incandescent lamps. For the past fifteen years, until two years ago, there has been no improvement of any commercial value in electrical incandescent lamps, but in the last two years the efficiency of these lamps has been increased from 3.5 watts per candle to 1.25 watts per candle, and it is promised by manufacturers that the tungsten lamp will be on the market early this fall and will be a commercial success, having an efficiency of 1.25 watts per candle-power. This being true, with a tungsten lamp of 50 candle-power, consuming 62.5 watts per hour, at the rate of 10 cents per kilowatt-hour the cost of operation will be 6.25 mills per hour, while the ordinary Welsbach gas lamp, using 4 feet of gas per hour and producing 48 candle-power, with gas at $1.00 per thousand feet would cost 4 mills per hour. This shows an excess cost over gas for operating the electric lamp of 2.25 mills per hour, and it is the first time in the history of the business that electric lighting has been anywhere near on an equal footing with gas.

Complaints

There is sometimes an inclination among subordinates of any gas and electric company to make the assertion that certain consumers who make complaints are kickers. Sometimes this is partially excusable, but this condition is absolutely wrong and every effort should be exerted to educate subordinates not to take this stand, no matter what the nature of the complaint may be. The consumer in making the complaint is virtually asking you to sell him your product, and you should be more than willing to make any reasonable adjustments necessary to that end. After a complaint has been adjusted a letter should be written to the consumer, stating what you have done and asking him if the work has been completed to his satisfaction. The object in doing this is to get consumer to write you a letter stating that his service is satisfactory in every detail. After he has once put this in writing you will find he will hesitate before making the statement to his friends that the company is giving poor service or is inattentive to the complaints of its consumers.

Gratuitous Work

The following is an excerpt from a recent issue of the *Looker-On:*

"The friendship of its community is the most valuable asset a public corporation can have. The company can win it only by deserving it, and letting the community know that it does deserve it."

This is strictly true in every sense of the word and should be lived up to conscientiously. In addition to carefully looking after your consumers' complaints, there is a large amount of work which a gas and electric company must perform free of charge in order to insure good and satisfactory service; for example, cleaning out service, testing pipes, capping an opening, equipping all burners in a house with new and up-to-date burners, inspecting plumbing during the course of construction of house, testing wire, repairing sockets, changing lamps, and so forth.

All of these are small details, which it is very essential the company follow closely in order to make sure that the consumer gets the best service possible with the gas or electricity he is buying; and I think I am safe in saying that if these details were left entirely to the consumer very few, if any, would be attended to. The result would be that the consumer would become dissatisfied and, as is usually the case, he would make the statement that the company furnished poor gas or electricity. It therefore remains for the company to protect its own interests by doing this kind of work *gratis,* and the least benefit we could expect to derive would be to use this as a means of cultivating the good will and friendship of the people, and incidentally remind them of the expense we have been put to in supplying them with their proper service.

To accomplish this and at the same time give no offense to the consumer, I would suggest sending him a bill, itemizing the material used, together with the amount of labor, as well as the cost of same; across the face of the bill stamp the words "No Charge," and mail the bill to the consumer, together with letter stating that you have done certain work or made certain changes, and ask him if the work is entirely satisfactory. This brings to his attention the fact that we have not only expended money in his behalf, but that he has received personal attention.

F. A. Willard

CO-OPERATION OF THE ELECTRICAL TRADE PAPERS IN BUSINESS-GETTING

In the past, and during the past year in particular, the trade papers have done exceptionally good work in assisting the new-business departments of the central stations throughout the country. The subjects treated have been many and varied. and the trade paper has been, not only the best medium for this work, but practically the only one that allows a broad, free channel for the interchange of ideas among the central-station men.

Some of the papers have even gone to the expense of detailing and sending out members of their editorial staffs to visit the central stations, attend local association meetings and report on same, the object, perhaps, being the obtaining, from the more modest central-station man, his ideas and methods that he is, possibly, too diffident to write about.

This spirit of willingness in the trade papers in sending out their representatives on this service, should be most heartily commended by every central-station man, and in return, each one should do all in his power to help out this good work by co-operating with the trade papers—this, not alone by the bare subscription to the paper itself, but by taking enough personal interest in the work to write to the paper, as occasion arises, of new schemes for getting business, new methods of advertising, or novelties in the matter of sign work and displays. New ideas for window display are always interesting to the new-business manager who has an exhibition room. A photograph of your exhibition and window display, or your company sign at night, a plan of the arrangement of exhibits, are all of value, and the trade paper is ready and willing to publish same. Co-operate with them. Let each and every business-getting department, from manager down to solicitor, carry out his part of the work.

During the past year the papers have, through their pages, circulated among central-station men much that is of value on the subject of business-getting. There have been a number of papers on the subject of the *Organization and Conducting of Contract Departments.* These have brought out the ideas of their several authors, many of the ideas being new to the majority of central-station managers. There is no doubt that, had it not been for the electrical trade papers, these new thoughts and ideas would have had no circulation among, nor value to, electric lighting companies' business-getting departments.

Not alone these papers on contract department organization, but whole pages in the electrical press have been devoted to showing advertising matter that has actually been used by the lighting companies in various cities. Photographs of exhibition-room displays and a great variety of sign installations have been shown. Illustrated articles have appeared in all of the leading technical papers on every subject that is interesting to, and advantageous for the solicitor to know.

The subject of heating devices and appliances has been carefully gone over, both by the manufacturer and central-station man. Interesting tables have been published showing current consumption and cost of operation under various rates, as well as cost of the article itself. Comparisons have been made of rates and methods for handling different classes of business. In fact, nearly every subject of interest has been covered in some way or other.

The work has been a success as far as it has gone, but it must go farther, and to make it do so, all must join in and help. There is not a contract agent in the country who knows every wrinkle for getting business, but undoubtedly each one does know some excellent points. Now, if each new-business manager will offer, from time to time, his best selling points, or have his solicitors write of their experiences to the trade papers, the latter will be only too glad to use such matter in their business-getting columns. This method of co-operation is absolutely imperative. The trade journals can not do it all; they have been of great service to us during the past year, and will be doubly so in the coming one, if the central-station men will but help them a bit by doing their share.

All of the leading technical papers have expressed the desire, as well as the willingness, to better their new-business-getting columns, but they one and all remark the apparent spirit on the part of the central-station men to receive all the information that they can through this medium, but to give none in return. The trade papers surely need our heartiest co-operation and assistance in making the coming year a success. They plan to enlarge their new-business departments, and to properly take advantage of this, all should contribute to help fill the additional space.

There is one of the technical papers that is, in a way, different from all others; that is the *Illuminating Engineer*. It covers what is comparatively a new field, and during this, its first year, has been most successful, as well as a distinct help to the progressive lighting salesman. It has thrown light upon subjects that the average central-station man has known but little of in the past. During the coming year this magazine plans to broaden out and devote more space to the commercial side of illuminating engineering. Papers on the subject will be written by practical lighting engineers, and the central-station lighting men should co-operate in any way they can to aid in the work.

The technical press has given us much in the past. It hopes and plans to give us more this coming year, but, to do this, it requests our aid and assistance. By helping it we help ourselves. A suggestion, a few words, a hint here and there, a plan or a photograph to the papers, and the thing is done.

Let each one show his appreciation of the success of the trade papers for the past year, and enthusiastically work to co-operate with them for this, the coming year. We must give a bit, not take all the while, and a successful year will result.

F. W. Loomis

CENTRAL-STATION SALE OF CURRENT

During the past year the *Electrical World* has followed with its usual care every phase of the central-station situation. One member of its editorial staff has since 1905 devoted his entire time to this side of electrical activity, his duty being to visit central stations throughout the country, attend meetings of the smaller electric light associations, and in notes, articles and editorials report from the field the current situation and new tendencies. In articles and editorials the *Electrical World* has striven to direct the attention of central-station men to new lines of profitable business in the sale of current, such as electrical refrigeration, automobile charging, solicitation of small residence lighting, introduction of electric cooking and heating, and so forth. In addition to the matter appearing in the ordinary issues, a special department in the monthly issue treats in detail of methods of central-station advertising, solicitation, and so forth. The illustrations are largely of advertising matter, bulletin covers, posters, billboards, signs, and methods of accounting, or keeping track of new business and prospects. In view of the fact that a very large percentage of current sold hitherto has been practically wasted through defective utilization, the *Electrical World* has given strong support to the recent movement to establish illuminating engineering on a basis upon which it can render valuable service to the central-station industry. Probably at least 1200 pages annually, profusely illustrated, or 50 per cent of the entire contents of the *Electrical World* (equivalent to about 5000 book pages), deal with topics that directly or indirectly affect the central-station industry.

Electrical World

METHODS OF GETTING NEW BUSINESS

In the issue of the *Electrical Review* for September 23, 1905, an editorial announcement was printed, to the effect that a department that would have for its purpose the stimulating of the demand for electricity would be established in a subsequent issue. This was the first instance where subject matter so entirely foreign to that usually found in technical journals was seriously thought of, particularly in the electrical field. In the issue of the *Electrical Review* for September 30, 1905, a department entitled, *Methods of Getting New Business* was established, two pages of news matter and illustrations being published, detailing what was being done in various parts of the country and describing the printed matter which was being distributed. This department has been maintained uninterruptedly since that time, week by week reflecting the work of the new-business getter in the central stations of the United States. On December 30, 1905, 45 columns had been published. This included original matter in the form of exclusive contributions to the *Electrical Review* by the foremost advertising experts of the day, abstracts of papers presented to the various electrical and allied engineering organizations, news items concerning progress in developing departments devoted to getting new business, and descriptions and criticisms of literature which the companies were distributing.

Realizing the importance of this department, and desiring to make it of the greatest value possible to our readers, we engaged Charles A. Parker to edit this department, beginning his labors with us the first issue in January, 1907. Since that time from nine to twelve columns of the best matter obtainable on this subject have appeared each week in the *Electrical Review*. This matter has apparently been very acceptable to our readers.

Notwithstanding the willingness of the publisher to expend large sums of money and a large amount of energy in creating and maintaining a department that is of very great benefit to the central-station manager, there has not been the co-operation and response that one would naturally expect under the circumstances. The spirit of accepting everything and giving nothing in return should be eliminated, and if the central-station managers would contribute to these departments out of their experience information similar to that they find of such value in these columns, the whole work would go along more smoothly and greater benefits would be derived.

This campaign has been very successful, but a good deal of educational work remains to be done. There is considerable apathy in many parts of the country, and where the managers of the companies are not sufficiently interested or financially able to embrace the opportunity afforded by the technical press in publishing these data, some arrangement should be made whereby the companies themselves should make it possible for their subordinates to get possession of this material.

Electrical Review

SELLING ELECTRICITY

An editor is a man who is continually soliciting other men to write articles for him; that is a very important part of his job. But when he is himself solicited to do a little writing he realizes that the shoe is on the other foot and understands why his eloquence in attempting to move the other fellow often meets such a reluctant response. But in the comity of the business it should be the part of all to give as well as to receive, of course; therefore, if you will permit me to dictate off-hand some observations about the relations of the technical journals to the new-business movement, as you request me to do, I shall endeavor to do so.

Of course, if the technical journals are worth anything they have been engaged in new-business propaganda ever since their establishment. It is the purpose of the technical journal to foster by every honorable means at its disposal the industry with which it is identified. In the case of the *Western Electrician* we have always tried to print material that would be helpful to the plant owner or manager in marketing his product. Articles and suggestions of this nature can be found scattered through all the volumes of the paper during its twenty years of life.

But it is true that it is only within the last two or three years that the subject of scientific salesmanship has been adequately regarded in the electrical business, and particularly in the central-station branch of that business. Even now the importance of it is only partially recognized. When one reads an article like that of Mr. F. H. Plaice, of New Bremen, Ohio, published in the *Western Electrician* of May 4, 1907, in which he shows that an electric light plant in a town of 1500 can be made to produce a gross revenue of $8.50 for every man, woman and child in the village, he begins to realize dimly the tremendous possibilities in the business of supplying electric light, heat and power. This shows what can be done in small towns as well as in large cities or those of medium size. Few places can show a record like that of New Bremen, but I think it fair to say that many central stations, and, in consequence, other electrical industries, are showing the favorable results of the "get-together" movement and the "hustle-after-business-as-if-you-meant-to-get it" movement established two years ago by those who afterward organized the Co-operative Electrical Development Association.

This co-operative movement was not without its effect on the technical journals as it was on others. It was a good thing for the papers to be induced to give more attention to this important subject and to present it in a way to attract more attention. The technical press, I believe, is always open to suggestions for improvement, and this was a very good suggestion.

In the case of the *Western Electrician*, we established a department under the heading—as we think the apt heading—*Selling Electricity*. This department made its first appearance in the issue dated October 28, 1905, and adopted as its slogan this declaration of intention:

"Under this heading will appear from time to time, articles, suggestions and examples which will be of assistance in the constant effort to increase the existing demand for electric current and to create new demands."

With this motto ever in view we have endeavored in this department and elsewhere, once a month or oftener, to help along the good work—to get out and shove—expressed in the terse motto of the association, "All together, all the time, for everything electrical."

We are very glad to take part in this important work, as far as we may amid a multiplicity of other duties. We are here to help the electrical industry, and whatever helps the electrical industry helps us. We expect to continue this department and to improve it, but we could improve it still more if the central-station men—and, indeed, all the electrical men—would co-operate with us by sending us an account, no matter how brief or how hurriedly written (we can do the "fixing up" easily enough), of any hint or wrinkle or suggestion or description or photograph or drawing or sketch of anything that will further the art of "selling electricity." I wish that this fact could be forcibly impressed on the minds and memories of the men who benefit, as we hope they do benefit, by our new-business department.

It must not be forgotten that as this whole movement is co-operative, so there should be active co-operation between the electrical journal and its readers. We are trying to help them; let them do their part and help us—not so much the *Western Electrician,* either, as its constituency, the great electrical public. Let us hear from you, you central-station men. What is your experience in increasing the day load; what in making rates attractive to the small customer and yet fair to the large one; what in advertising and soliciting; what in electric heating and cooking; what in the possibilities of sign work and advertising illumination; what in any branch of the business in fact, where a record of your work and your efforts will be a benefit to your fellows?

In short, the *Western Electrician* is anxious to further "selling electricity" by every means in its power, and to that end we shall be thankful for any suggestions or help we may receive from any source.

William E. Kelly, Managing Editor
Western Electrician.

THE COMMERCIAL ENGINEERING OF ILLUMINATION

Replying to your favor of April 26th, I gladly comply with your request for a review of the work done by *The Illuminating Engineer* bearing upon the work of the Co-operative Electrical Development Association.

The chief aim and purpose of *The Illuminating Engineer* has been, thus far, to establish illuminating engineering as a recognized branch of engineering practice. While the treatment of illumination as an engineering problem had been done in scattering cases previous to the appearance of our publication, the actual recognition of this new and important branch of science may be fairly said to date from the founding of the Illuminating Engineering Society and the establishment of *The Illuminating Engineer,* which were practically simultaneous, although entirely independent in their conception.

As stated in the fore-word of the first issue, *The Illuminating Engineer* is primarily a technical journal, and while it does not deal directly with commercial problems to so large an extent, its work as an aggressive missionary in the propaganda for better illumination has tended directly toward commercial results in a way that no direct efforts could accomplish.

Early in its career a department called "Commercial Engineering and Illumination" was introduced. In this department the various papers presented before the different commercial organizations, which were primarily of a commercial nature, were printed.

The remarkable succession of improvements announced during the past year in the means of producing electric light have naturally given the preponderance of matter and attention to electric illumination, although it is intended to treat all forms of illumination with impartiality. The value of illuminating engineering as an adjunct to the commercial department of the central station has been recognized very generally among the central stations, many having established a special illuminating engineering department.

It is our intention during the coming year to enlarge the scope of the commercial engineering department and make it one of the important features of the magazine. It will be our special aim to show how illuminating engineering can be used as a successful method of securing and retaining lighting business. To this end special articles will be contributed by those who have had practical experience in this line, and an effort will be made to secure the co-operation of all central stations that have taken up the matter in connection with their general plan of business getting.

We believe that the time has passed when the ordinary salesmen's tricks will suffice in the selling of electric current for illuminating purposes. The public is being rapidly educated in regard to matters pertaining to illumination, and the salesman who will be most successful is the one who can offer the greatest amount of assistance in giving customers the best possible illumination for their money. In short, the lighting companies must sell *light*, and the salesman who offers his customer what he wants is the one who gets the order; and what the consumer wants is not kilowatts, but *illumination*.

In this broad and fundamental sense, therefore, the entire work of *The Illuminating Engineer* has been directed toward the commercial success of illuminating companies.

E. Leavenworth Elliott, Editor
The Illuminating Engineer.

CHAIRMAN FREEMAN: We now have a short time for discussion, if any wish to engage in such discussion.

DISCUSSION

MR. P. H. KEMBLE (Windsor Locks, Conn.): I have been very much interested in the papers read this morning, but I notice that in giving the possible *per capita* earnings there has been no mention made of the character of the inhabitants. I should like to ask a question relating to this, as I was talking over the subject last night with some central-station men who felt the same as I do about it. In one of our towns, of 7000 inhabitants, we have a large carpet mill employing 3000 operatives. The bulk of these operatives live in tenements. In the experience of any of the members here, what proportion of these operatives is it probable can be reached either with gas for cooking or electric light for other uses? In another town we have about 2500 mill operatives, employed in textile mills and paper mills, living either in small houses or in tenements. What possible proportion can be reached either with gas or with electric-light service?

CHAIRMAN FREEMAN: As this matter was covered particularly in Mr. Tait's paper, I will ask him to answer.

MR. TAIT: Probably the best answer may be obtained from Mr. F. H. Plaice, of New Bremen, Ohio, who is here. Mr. Plaice has both gas and electric light to deal with, and has been able to get $8.50 *per capita.* He will be able to tell you how many buildings there are in his town using electricity. I understand many of his consumers receive not in excess of $1.50 per day. If they are able to use electric light on an income of that kind, the people you mention should be able to use electric light.

CHAIRMAN FREEMAN: Mr. Plaice is on the programme. We do not wish to anticipate his paper, but if he desires to give this information we shall be glad to hear from him.

MR. PLAICE: We are lighting to-day 85 per cent of all the buildings in our town. Many of our customers earn as little as $1.25 a day, and I perceive no reason why any person who makes $1.50 a day can not be reached for electric light if the proper price for current is charged and the proper conditions for delivery of current are met.

CHAIRMAN FREEMAN: What are your charges for residential service in such cases?

MR. PLAICE: We work on a demand system, based more particularly on the area to be illuminated than on the amount of lighting installed. The rate starts at 20 cents for the first 7.5 hours out of the 30 hours per month. It swings to 10 cents for the second 7.5 hours, than 9 cents for the next 15 hours; or an average of 12 cents for the first hour per day per month, then 6 cents for the second hour, 3 cents for the third hour, and after that 2 cents a kilowatt-hour for all current. We use gas engines. Our gas company has seen fit to reward our efforts by charging us 10 cents a thousand more than it charges other customers. We pay 35 cents a thousand for gas.

CHAIRMAN FREEMAN: We will now have the series of papers on the subject of wiring.

The following papers were read: *How to Get the Old Buildings Wired,* Mr. F. H. Golding, Dayton, Ohio; *How to Get the New Buildings Wired,* Mr. J. Sheldon Cartwright, Knoxville, Tenn.

Wiring

HOW TO GET THE OLD BUILDINGS WIRED

Great possibilities for remunerative business in lighting are offered by the residences, and central-station men generally are awakening to the fact that a strenuous effort should be made to secure this class of business, particularly the old houses in which gas or some other established illuminant offers strong competition.

The campaign outlined in this paper has produced most gratifying results and is adapted to the needs of the average central station, subject, possibly, to minor changes or modifications made necessary by local conditions. To attain the highest efficiency, this campaign should be supplemented by a liberal policy as to the kilowatts connected for which service will be furnished. One central station that has been very successful in securing old house business by these methods—in fact, increased 700 per cent in 18 months—will give service to any installation, no matter how small the current consumption promises to be, on the assumption that the use of electricity even in the most trivial manner soon becomes a habit and inevitably leads to a more extended use.

As a preliminary, a house-to-house canvass of the residential districts should be made, the information thus obtained to be compiled in card-index form, containing the street and number of each house, name of owner, name of tenant or tenants, means of illumination in use, and, if electricity is not used, whether or not the house is wired. With this information available the solicitor is in a position to work his district intelligently and systematically, canvassing a block at a time and persisting until he has had one or more interviews with the head of every family in his district. After the preliminary canvass he may select those offering the most favorable prospects and concentrate his efforts on these selections, endeavoring to have not less than one or two on each block in his territory.

The head of the new-business department, being informed by daily reports as to the progress the solicitor is making, should aid him with mailings of personal letters and literature pertaining to various lighting and power appliances for the home use.

If the solicitor is at first unsuccessful in interesting the prospective subscriber to the extent of lighting his entire premises with electricity, he should endeavor to secure an entering wedge in the shape of a cellar or porch light, an electric iron, sewing-machine motor, or any other appliance that he thinks will most appeal to his prospect, offering the free use of same for a 30 or 60-day trial, provided the prospective customer will pay for the small amount of wiring necessary and for the current consumed.

It is right here that a liberal policy on the part of the company is of vital assistance to the solicitor, as the appliance most favored may be a heating pad, night light, or something else in which the current consumption is negligible. Having obtained a foothold, it is comparatively easy for a capable solicitor to gradually extend the uses of electricity in a home by a diplomatic and unobtrusive introduction of other appliances, so that almost before the householder realizes it he is relying on electricity for his light and various other needs and wondering how he could have gone without it so long. The enthusiastic testimonial of the pleased subscriber thus obtained is of material assistance to the solicitor in his work in neighboring houses, hence the importance of obtaining at least one on each block.

In conjunction with the solicitor's work, a good series of newspaper advertisements should be used, care being taken to have the copy attractive and readable and arranged to fit the season or local conditions. For instance, in the fall, when lengthening and chilly nights offer the opportunity, devote the article to porch lights or electric radiators; in the winter, when the furnace must be cared for, to cellar lights; in the holiday season, to attractive gifts, such as chafing dishes and coffee percolators; in the spring, to flat-irons, fans and other electrical hot-weather comforts; in epidemics of sickness, to heating pads, sterilizers, turn-down lamps, and so forth. In addition to the work above outlined, very good results can be obtained from a special advertisement inserted in the "For Sale or For Rent" columns at intervals, advising the prospective purchaser or lessee to consider the desirability of electricity and avoid houses without it. These should be brief and pointed, and alternated with appeals to the real-estate dealers to wire all their houses and thus secure higher prices and easier sales. Pamphlets, flyers and other mail matter, seasonably selected and pertaining to local uses or events when possible, should be freely used. The accompanying illustration of a "Burglar" pamphlet, issued at a time when several burglaries had occurred in succession and the city was much aroused in consequence, is a good example of what this class of matter could be, and was directly instrumental in securing many customers.

FIG. 1—ILLUSTRATION FROM "BURGLAR" PAMPHLET

A liberal use of small electric signs, scattered freely through the residential sections, and of illuminated billboards is a valuable adjunct to residential work. The signs should be of the picture-frame variety, to facilitate handling, and should be changed to new locations twice or three times a year.

Arrangements can be made with store or shopkeepers, by making a concession in their lighting rates, for the location of signs on their buildings and the switching on and off—the company's trouble men, or sign men if it has them, caring for the renewals.

The billboards should be erected in favorable positions, preferably along the routes of the street-car lines radiating out into the residential districts, and should be repainted at least two or three times a year to retain the interest of the passing public.

Trough reflectors may be used for the illumination, and the reading matter and illustrations should bear on the uses of electricity in the home. A time switch may be used to control the lighting, unless the central station maintains a sign-switching service.

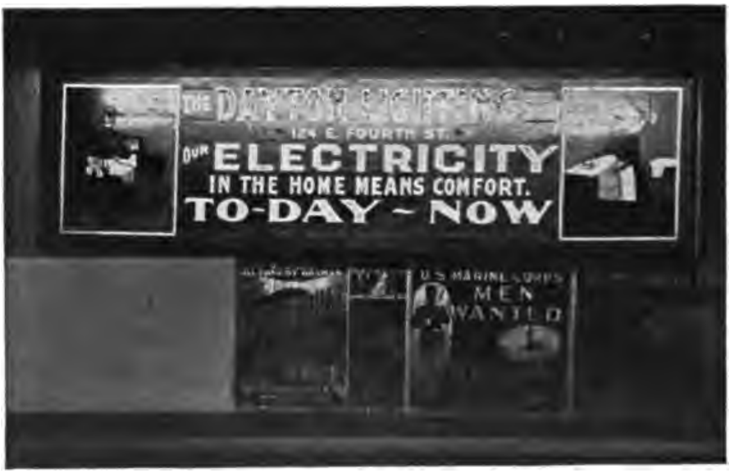


FIG. 2—ELECTRIC SIGN

The company should be prepared, where conditions seem to warrant and the prospective customer's responsibility is assured, to offer a proposition whereby the installation of wires and fixtures may be paid for in instalments—weekly, monthly, or quarterly, as may be desirable. By this means many customers can be secured who would not otherwise feel able to meet the installation expense. If the central station does not do interior work, a satisfactory arrangement could be made with the electrical contractors whereby the latter would add, say, 10 per cent for interest and the expense of carrying the account, the lighting company guaranteeing the contractor against loss. As the cost of the average installation will not exceed $100, the percentage added will lay no great burden on the customer.

A number of central stations about the country have in effect a plan whereby a certain number of outlets is installed at or below cost, and some of them are obtaining very satisfactory results, but propositions of this character must be governed entirely by conditions existing in the territory served and should be carefully considered. In one city recently brought to the writer's attention, where the lighting company installed the first work with its own men, the practice was discontinued because the contractors regarded it as a usurpation of their prerogatives, and when called upon to furnish estimates for wiring the remainder of a house would add to the estimate a sum equivalent to the assumed profit they would have received on the original work. In another city, where the lighting company arranges with the electrical contractors to do the work and pays them the difference between the amount the customer pays and the normal price for the installation, the plan has worked out well.

The question of getting new houses wired is so closely allied with the one under discussion that a few words on the subject may not be amiss here.

In growing cities it is advisable to maintain solicitors exclusively for this business, averaging one man to about 50,000 to 100,000 population, depending on how rapidly the city is growing and new houses are being erected. It should be the duty of the "new-house man" to keep track of the building permits and of the building-trades notes, to keep in close touch with architects, builders and real-estate men, and a generally watchful eye on new building. In the latter he will be aided by the daily reports of the district solicitors, who should be required to note on their reports the building preparations in their districts.

He should receive the same assistance in the form of follow-up letters and other mail matter that the other solicitors receive, and, in addition to that, a special mailing series to architects, builders and real-estate dealers should be used. The special series, supplemented by frequent personal letters proffering the services of the company's illuminating and construction engineers in laying out the supervising and installation of distributing systems free of cost to the persons addressed, could consist of mailing folders containing illustrations of successful residential lighting effects, preferably local, and reading matter descriptive of and calling attention to the illumination in the picture. One lighting company in a city of about 100,000 population adopted a similar plan for its new-house work with the result that, while less than 10 per cent of the new houses built in the city during the first five months of 1905 were wired, during the same period in the current year 92 per cent were wired.

F. H. Golding

HOW TO GET THE NEW BUILDINGS WIRED

This is a subject that seems, upon mere cursory consideration, to be of small account and not worthy of more than a passing thought, as compared with the many momentous questions which confront an association of this kind, with its great diversity of practical and theoretical interests.

It seems almost a sacrifice of our time and energy to question for a moment that in any community with modern ideas and practices on this hustling globe of ours, with the seemingly inexhaustible developments that are being made in electrical science and appliances, there could exist a man, body of men, company or corporation, that would erect any kind of a building, for any purpose whatsoever, except a dungeon or perhaps a gasometer, unless it were wired for the use of electricity and the various appurtenances connected therewith.

Well, you say there are just such in existence, and how, then, can we overcome the various objections that are raised against the consummation of what is really the bed-rock foundation of this association and its desires.

You think this is a little too strong, do you? But is it? If new buildings were not wired, we should then be obliged to depend upon our municipal lighting or buy up a railroad and generate our current to run it, and surely if new buildings were not wired people could not see the multitudinous advantages of electricity, consequently there would be little desire to wire old buildings; one being contingent upon the other, we should thus have a limited field for action.

There are really many more phases to this question than appear upon glancing at the title of this paper, among which are the cost, questions of desirability and necessity, risk of fire, danger to life, and, many times, the perverseness and stubbornness of human nature to awaken to the fact that the world "do move," and that new buildings, both large and small, must embody the latest feature of modern engineering in this era of triumphal progress to make them attractive to the people for whom they are constructed, and by whom they are to be occupied.

Let us first consider the cost. This is given precedence in the list of objections, as it certainly stands pre-eminent and is one of the hardest to overcome; it is the basis of all interest, tax, rental and depreciation charges. With iron and terra-cotta construction, of which nearly all the large buildings are composed, I believe the cost, after being presented as a total, should be analyzed on a relative percentage basis—that is, per outlet, per light, per square foot of office and corridor space, and so forth, so as to be able to talk in small figures while keeping in mind the many advantages for your reserve force; before making use of the latter you still have other places upon which you can concentrate your energy. They are, first, the architect, and next, the builder.

As a general rule the majority of building syndicates, as well as individual owners, place implicit confidence in some one firm of architects and give careful consideration to any recommendations that the architect may make to them. Outside of the pecuniary gain that results to both the architect and builder on account of the increased cost, the architect occupies the same relative position to the owner as a lawyer does to his client. To the architect, then, your central-station solicitor should turn and continue his endeavors and make his arguments as to the advantages of having the proposed building wired. He should offer to assist in the layout of the lights, outlets, and so forth, so that the most advantageous conditions can be realized; he should supply the architect with all necessary data and literature of the various electrical appliances, labor-saving, heating and cooking, signs, motors and general illuminating in its various forms—in fact, everything up to date that he can conceive of or suggest—and should keep up a persistent, but not obnoxious, hammering until he has gained his point. If possible he should arrange a meeting with the architect and owner together; and there is one thing that he should always remember, and that is, that those to whom he is talking, whom he is trying to convince, are not supposedly technical on electrical matters, so instead of talking about volts, amperes, kilowatts, and similar terms, he must remember to talk plain, everyday dollars and cents. I mention the builder in passing, but do not consider him of prime importance on this preliminary solicitation, though I believe he is often of sufficient weight to keep in touch with, as he is frequently called into consultation with the owner and architect on many details of construction. He is constantly erecting all kinds of buildings, both large and small, and, like the wiring contractor, comes in contact with people of all shades of opinion, and I think, as a general rule, is more in touch with the public pulse and so realizes more of the general requirements of the people at large than many of the architects, and can surely be made use of in presenting our final arguments.

There is still one other your solicitor can make use of, and that is the wiring contractor. There should exist an *esprit de corps* between the central-station company and the wiring contractor, as there exists oftentimes among the general public a feeling that the solicitor representing a lighting monopoly is actuated entirely by selfish motives, and people are therefore more inclined to turn down his arguments than those coming from a less interested party. The wiring contractor, while having an interest in the wiring, does not derive any income from the use of it after the current is turned on, and, consequently, can not be accused of having an entirely selfish interest in having the building wired.

As to the risk of fire, I think, as a rule, there need be little real objection to having a building wired where the work is done by a reliable concern, with first-class, well-paid and conscientious workmen, under the stringent rules of the insurance companies, and oftentimes the municipality, together with constant and eagle-eyed inspection under these rules as the work progresses. These conditions ought to present to the most obtuse and conservative owner the strongest arguments that could be offered against any objection he may make on account of risk of fire.

As to the danger to life, there are probably many who have a natural timidity for nearly everything they do not understand or can not see, outside of the ordinary humdrum affairs of everyday life. Of course, to combat these objections we have statistics to prove that there is very little loss of life from electricity, and furthermore, I believe that but little argument will be necessary to prove that there is no one commodity so universally used under all kinds of conditions that has caused so few bad accidents as the electric current.

In this particular line I believe but little time should be wasted in argument. The old saying "seeing is believing" is as true to-day as it was years ago, and it is only necessary to get your prospective customer to your well-equipped show-room and there demonstrate plainly what you have been saying verbally. I believe that a little time spent in this manner generally accomplishes more than many hours spent in talking.

Your solicitor, if he has not up to this time wholly accomplished his purpose, can then call in the specialists. This is your reserve force, and by these I mean the elevator companies, the companies with the various electrical office devices, the fixture company, the heating, cooking and ventilating devices; after all these have had their say and presented their arguments, the prospective owner is probably ready to succumb to any proposition that will get his building wired and restore him to his normal condition.

While these general ideas apply to the larger buildings, on a different scale they also apply to the smaller buildings, by which I mean the houses which are built for their owners' occupancy or the houses that are built to rent or to sell. I believe in furthering the wiring of this latter class of buildings and that a well-posted lady solicitor can accomplish in a great many instances more than a man. It would be advantageous for the larger lighting companies to have at least one lady on its corps of solicitors—one who is not only a good talker and demonstrator, but who has had practical everyday experience with the sewing-machine motor, the electric flat-iron, the heating pad and the various electrical heating and cooking utensils; one who has used and thoroughly understands the handling of these various devices, who can talk intelligently to the housewife and create the desire for their use—then you know the result; the new house has certainly got to be wired, and no further argument is necessary.

If a family has once had the conveniences and comforts of an electric installation, it is very rare that it will move into a building in which one is obliged to hunt around for a match every time a light is wanted, and will not put up with the trouble, dirt, heat and smoke of any other form of service, and, as for buying a building or home that is not wired, they will stand for almost any other omission without fault-finding, but not the lack of wiring.

There is one more objection of which I made mention, and that is personal characteristics—although I called it by a different name previously. Some people are hard to convince—they refuse to be convinced—and that certainly makes it a hard proposition for the solicitor. He must talk of the desirability and necessity, the many advantages, the enhancing of values, the greatly-increased cost after completion, but must not seem over-desirous of selling the current after it is wired. Keep that in the background, but keep it in mind; be quick-witted but not quick-tempered; expect and receive abuse but do not give it; forget it and be a diplomat, but constantly keep pictured in your mind that building being erected, all those wires going into it and the current coming from your station and going onto those wires—do not forget that.

There is one more phase of this question that I have not taken up before, but of which I will make slight mention before closing, and that is advertising. The various visits of your solicitor should be interspersed with some judicious advertising matter. By this I do not mean large bulletins with art-gallery covers and miscellaneous contents, but more in the small pamphlet form, with short, pithy arguments covering the particular result you are trying to accomplish. Remember that what is worth accomplishing is worth going after, and that good, intelligent, personal solicitation has caused more new buildings to be wired than all the printer's ink ever made. The age of generalities has gone and we are now in an age of specialties, and while versatility is a good thing at the dinner table or at some social tea, it is the man in business who specializes that draws the largest salary; for that reason the solicitor seeking to get new buildings wired, who has the greatest success in this line, has got to school himself to be a specialist in this branch of electrical work.

J. Sheldon Cartwright

Chairman Freeman: We are glad to welcome to our convention the president of the National Electrical Contractors' Association of the United States, who will speak to us on the subject of *Co-operation of the Electrical Contractor in the Wiring of Buildings.* I have the pleasure of introducing Mr. James R. Strong, of New York.

Mr. Strong presented the following paper:

CO-OPERATION OF THE ELECTRICAL CONTRACTOR IN THE WIRING OF BUILDINGS

The National Electrical Contractors' Association, which I have the privilege of representing on this occasion, feels greatly honored and gratified at this, its first official recognition by the oldest and most influential trade association in the electrical field. I am glad of the opportunity afforded me to place before you, for your consideration from the viewpoint of the contractor and his association, the important subject assigned to me, *viz.:* "Co-operation of the Contractor in the Wiring of Buildings."

With all due deference to my worthy friend who is chairman of your "Committee on Hot Air" for to-day, I feel that he should have stated the subject a little more broadly. It should read *Co-operation of the Contractor in Business-Getting,* for I think I can show you that the contractor and his organization can aid this great movement for business-getting in several ways other than the simple installation of wires and appliances.

For the sake of brevity and greater clearness, I would divide the subject into three parts:

First—The wiring of buildings.

Second—Standardization of work, materials and appliances.

Third—The recognition of the trade relations of the several factors that enter into the electrical business.

Under the first heading the co-operation of the contractor is assured, for it is the very essence of his business to seek to wire buildings. His daily effort is in the line of increasing his business, but I believe that in most cases this effort is misdirected and wasted. I think that the contractor devotes less energy to obtaining new business than to the execution of the business in hand. Contractors, as such, are not advertisers; they rely almost entirely on personal effort for the extension of their business, and as this personal effort must also supervise the work in hand it naturally follows that the solicitation part goes to the wall, and as a result the contractor's business continues without substantial increase from year to year.

Many improvements are possible in this direction. Advertising should be employed to a reasonable extent, not necessarily of the spread-eagle type, or to a great extent in our excellent trade papers which reach principally our own trade, but in some medium which reaches the general public, and particularly those interested in building. I am a great believer in the typewritten circular letter to architects and builders, if properly followed up, and also in the reports of a reliable concern giving advance information of building operations, if properly followed up. But, gentlemen, the letter and the report are rarely followed up. The letter leaves our office and the report is put in its pigeonhole and not thought of again. And why? Because the contractor has too much to do in supervising his work and collecting his accounts. He has not organized his force so that a competent clerk looks after the office work and collections, and a trustworthy superintendent takes care of the details of construction.

Co-operation of the contractor, then, under my first heading, means the perfecting of his own organization so that the detail work will be done by subordinates, and his own time may be devoted to following up his various forms of advertising and extending his business of wiring buildings.

My second heading, gentlemen, is worthy of your serious consideration. It seems to me that nothing is of greater importance to this movement for extending the electrical business than that the fly-by-night, trouble-breeding, flexible-cord installations and their like be relegated to oblivion. Gone are the days when we wired whole houses on one circuit of No. 14 wire, or lighted hotels with seven lights in series on 600 volts, but there is still much room for improvement. I assume that it is not the desire of the Co-operative Electrical Development Association to extend the electrical business in "any old way." I take it for granted that it is its desire that extensions made shall be of such permanent and substantial character as will tend to place the electrical business on a more firm and wholesome basis in the eyes of the public.

The contractor and his organization have been co-operating for a long time along the lines of standardization in several ways:

With the Underwriters for the improvement and simplification of the *National Code* and its uniform interpretation.

With the manufacturers for the standardization of sizes of various fittings and appliances.

With various legislatures for the standardization of work by licensing and bonding the contractor.

With the architects for the introduction of uniform symbols for wiring plans.

The *National Code* as it stands to-day is undoubtedly a remarkable piece of work, but as it has been added to from time to time it has become so complex that a revision and recodification are essential. The question of uniform interpretation is much more difficult to accomplish for the reason that the different insurance associations which support the National Underwriters' committee are independent bodies and each supreme in its own territory.

Much has been written of late on the subject of licensing the contractor. It is not my purpose to go into this subject in detail, suffice it to say that experience has shown that where states or municipalities have enacted a law requiring the licensing and bonding of contractors no one thing has done so much to eliminate the irresponsible worker and dangerous work.

At first glance the matter of uniform symbols for wiring plans may seem unimportant, but the general interest aroused among architects, engineers and technical schools by its introduction demonstrates the necessity of standardization in this department. I am glad to announce that on May 20 the American Institute of Architects formally adopted our symbols with only two minor alterations, and hereafter they will be issued under the endorsement of both associations.

Under my second heading then, gentlemen, I promise on behalf of the contractor his continued co-operation along the lines of standardization, and I appeal to all the interests here represented to join in this great work, knowing full well the vast powers which could be jointly exerted on the insurance companies and lawmakers for the standardization and permanency of the electrical business.

I come now to the third and last subdivision of my subject, *viz.:* "Recognition of the trade relations of the several factors that enter into the electrical business." I hear some one saying, "What has this to do with the plan of business-getting?" I have heard a very wise and brilliant man say when I mentioned this subject on a previous occasion, "Let us catch the public first, and settle these internal differences afterward." I tell you, gentlemen, the secret of the success of this co-operative association is that all shall contribute to its support, and the secret of its ability to obtain substantial contributions toward this great movement of publicity and extension from all interests is that its influence shall be such that the business secured by the various interests shall be profitable. In my opinion this co-operative association can do nothing of greater importance than to use its influence to draw lines of demarcation between the various interests here represented. If through the influence of this body it can be accomplished that the lighting company shall do no wiring, concessionary or otherwise, and shall not sell supplies at wholesale or retail; that the jobber shall do the wholesale business and sell to the retailer and not to the retailer's customers; that the contractor or retailer shall purchase through the jobber and confine himself to the retail and contracting business; then this Co-operative Electrical Development Association will have demonstrated beyond a doubt that there is reason for its existence, and its support will come from all in the trade and not as at present from a comparatively few manufacturers; gentlemen, I think I am safe in saying that, with the exception of the manufacturers protected by patents, many interests here represented feel that their business is not bringing them the profits to which they are reasonably entitled, and attribute this condition largely to the cut-throat methods existing throughout the trade.

Can the jobber and contractor look with favor on a proposition to boom the business of the lighting company which, for the purpose of extending its business, sells thousands of fans to the public at manufacturers' prices? Can the jobber and contractor be expected to grow enthusiastic over the idea of contributing to increase the business of the lighting company which purchases its supplies from the manufacturer and employs a hundred or more men in wiring buildings for cost or less? The answer must be "No," unless the electrical trade has reached a more advanced stage of philanthropy than I think it has.

But let us not look entirely on the dark side of the situation. I know of several cities where lighting companies and contractors are co-operating, and I was fortunate enough recently to help make a very valuable co-operative agreement with a prominent lighting company in our vicinity. I know also of several localities where even jobbers and contractors are co-operating on the line of wholesale and retail. Let the good work go on. It needs the valuable influence of this body, the spirit of co-operation, and a few high lights thrown on the question, to work wonders in our trade.

Mr. President and gentlemen, I thank you for listening so patiently to my somewhat rambling discourse. I am loath to introduce any discordant note into this very peaceful assembly, but I am firmly convinced that real and effective co-operation will not be attained until steps are taken with a view to clearing up some of the discords I have endeavored to point out. In conclusion: let us all co-operate in increasing the wiring of buildings; in the standardizing of such wiring, and in perfecting such relations as will make such wiring profitable to all concerned. In the words of the immortal Crouse, push "all together—all the time—for everything electrical."

James R. Strong

DISCUSSION

CHAIRMAN FREEMAN: We appreciate Mr. Strong's frank expression of his views. Those who know him know that he always has the courage of his convictions; and while I am sure that he will appreciate any favorable comments that may be made on his paper, I think I know him well enough to say that he will not misunderstand any differences of opinion that may be expressed. On this problem of wiring—of both old and new buildings—I am sure there are those present who have had experiences that will be helpful to us, and we want to hear from them for a few moments.

MR. LAWRENCE MANNING (Owosso, Mich.): I believe, much as Mr. Strong has pointed out, that if the electrical contractor is not left free in this matter it leaves us open to the criticism on the part of the public that we are getting so much out of the electric-lighting business that we are able to do wiring at cost and sell appliances at cost. I think that is a very bad practice and puts us in a very bad light. We must make the profit out of the sale of current, if not out of the apparatus sold, or else we shall soon be out of business; and I think we should protect the wiring contractors in this respect.

MR. M. S. SEELMAN, JR. (Brooklyn, N. Y.): As I take it, the vital point with the central station is not who wires the building, but that the building be wired. Now, as a corollary of that very vital point, it follows that in any place, in any town, where the contractors are strong enough to take care of the conditions as they exist and wire the buildings as they are built, that should be wired and ought to be wired, the central station is not likely to interfere. It seems to me, therefore, that the matter is largely in the hands of the contractors themselves—at least, as much as it is in the hands of the central stations. As Mr. Strong admits in his able and interesting paper, the contractors have not as yet organized into an efficient business-getting force, and it seems to me that while he has advanced a proposition with which we are familiar, and which it will become us well to take into consideration, at the same time the contractor must himself put his house in order, and must make every effort to do the business that should be done, or else he lays himself open at all times to possible interference from central stations, for their own protection.

MR. LEON H. SCHERCK (New York city): Mr. Strong asks, on page 84: "Can the jobber and contractor look with favor on a proposition to boom the business of the lighting company which, for the purpose of extending its business, sells thousands of fans to the public at manufacturers' prices?"

Associated as I am with a number of electric-lighting companies in different sections of the country, I can say unqualifiedly that we have found that the best solicitor the central station has is the wiring contractor, and that it is not a very difficult matter for the central station to co-operate with the electrical contractor, provided the preliminary steps are taken by the central-station manager. In co-operating with the electrical contractor, it is not necessary to sacrifice any new business, and it is not necessary that any of the different schemes for increasing business be done away with. You can wire houses, sell fans and flat-irons, use hylo lamps, and so forth, and still do this with the encouragement of the electrical contractor. How can this be done? Take, for instance, one situation in the Middle states, where we thought it was a good plan to wire six outlets free for a limited time.

We succeeded in wiring up, in a city of perhaps 100,000 inhabitants, some 1600 residences, with the aid of the contractors who helped us go after the business. We supervised the business. We got the electrical wiremen together, had a talk, drew up specifications, and placed all the work in the contractors' hands. They were willing to take the business at a modest figure, as they realized that their profit would come from the fact that, having once made the householder acquainted with the conveniences of electricity, more work and continued sales would be brought about. We considered it a better plan to have the contractors do the wiring, even at somewhat higher figures than we could have done it ourselves. In some situations we have regular meetings with the various electrical contractors, and at these meetings any grievance against the company is freely discussed. As, of course, we always intend to give every one a square deal, it is seldom that any matter is brought up that can not be settled to the satisfaction of all concerned. The central-station manager should make it his duty to keep in close touch with the electrical contractors. If any of the company's rules and regulations are unjust, of course they should be changed. Too much should not be left to subordinates. A little personal investigation on the part of executive officers often reveals conditions that are not even suspected.

A number of central-station men with whom I have spoken on this subject of co-operation have not agreed with me on the theory that every tub should stand on its own bottom, but in the situations to which I have referred I have found it works out very well; that good results are accomplished, and, so far as we are concerned, speaking for a number of cities in the central southwestern states, we are more than gratified with the spirit of co-operation that we have brought about between the central-station management and the electrical contractors, and, so far as it lies in our power, we intend to keep it up.

On page 172 the statement is made: "In some instances it may be necessary to install a motor free, if it secures a particularly favorable business. The rate per kilowatt-hour can easily be increased to cover the cost of the motor." I have always found that the most difficult thing to do is to increase the rate, and unless absolutely necessary it is the worst thing a central station can do. Then, too, if there is anything public-service corporations should get away from it is special rates, and if we do not get away from them willingly we may be forced to get away from them. In an extreme case I would rather make a present of the motor than to vary the rate.

On page 173 Mr. Tidd says, referring to off-peak business: "This class of business does not seem to have been given the consideration it deserves." My observation is that the central station has not given enough attention to this off-peak business. We were enabled to close in one central station an installation of over 1000 horse-power with an off-peak clause at a rate we could not have made if that clause had not been in the contract. Take your financial statement, and see what an enormous difference there is between the cost of peak business and off-peak business. I think the off-peak contract is something that is in an experimental stage, and something that can be worked out satisfactorily. It has been worked up to a considerable extent in a city in Canada, I understand. I think it is possible to do something in this matter through the co-operation of the labor organizations, which might be interested in having different hours of labor during the winter months. It is not a bad thing for a laborer during the holiday season to be able to get off at half after four or at five o'clock, instead of at six, by going to work an hour earlier. I think that by persistent effort we could work up a good deal of off-peak business that is now taken care of by isolated plants.

Mr. W. P. Engel (Defiance, Ohio): I have been listening to our friends talking on co-operation. It is good, but we do have central stations that say: "We do not want to co-operate with the contractor; 'let every tub stand on its own bottom,' as they say." In my particular case, I am not far from Toledo, and the contractors come into our town from that city. Sometimes these contractors cut the price, and when they get to cutting the price they also cut the capacity of the wire into the building, and that is just as bad for the central-station man. We have invited contractors to come to our city and do the work. The central-station man does not want to do wiring if the contractor will do it and give the customer full value. The result has been that in the last five years we have had six different firms come into our town to do wiring, and we have got into difficulties with some of these outside firms because we have asked them to pay us $1.00 for examining the wires and connecting up the meter.

They think we should be willing to examine the wires and set the meter free of charge. I am not fighting the contractor, and am more than heartily willing to co-operate with him, but it is the kind of contractor that we run up against occasionally that makes us so much trouble. If the contractor were a man who understood his business, and not a wireman who had learned the business in two weeks and had come into town expecting to do all the wiring there was to be done, we should get along better.

We have been up against the question of unions. In many cases the central station has been compelled to do wiring and give the customer the most for his money, and in my case I assuredly put in a service that is twice the capacity of the installation.

MR. GEORGE R. STETSON (New Bedford, Mass.): I remember a few years ago hearing the manager of a large company say that in this district they gave up doing wiring themselves, and their solicitor gave his attention to finding new buildings. Then he sent notice of the fact that a building was to be wired to every contractor in his city. He said that one of three results followed: The man either wired his house, moved out of town, or died. In our own work we carried on the matter of wiring for some time, until we found we were not producing the proper results, and then we turned our crew out into the general market and let them shift for themselves. The way we helped them was to buy in larger quantities and sell to them as cheaply as we could. We helped their interests as much as possible in that way, and it has resulted satisfactorily in the extension of our business. They looked after their part of it.

CHAIRMAN FREEMAN: When we have discovered the means of accomplishing the result indicated by Mr. Stetson, it is time to close the discussion. We will now take up the papers under the heading *The Solicitor,* and will have the paper on *Value and Use of Solicitors' Handbook,* by Mr. R. S. Hale, of Boston.

Mr. Hale presented the paper, as follows:

The Solicitor

VALUE AND USE OF SOLICITORS' HANDBOOK

The *Agents' Handbook* as used by the Boston Edison Company is, to my mind, the most important aid to new-business-getting we have.

We use the ordinary loose-leaf book of pocket size, either National Simplex 4241 or Unimatic 7752, and put in it all the hints, suggestions and orders touching the interests of the general agent's department. The general advice as to the qualifications and aims of the agent and the specific information about the company's business, which varies little from year to year, are printed in the regular way. Other details, regulations, and explanations of particular points, are gotten out on a multigraph machine and distributed as occasion serves.

Last autumn I started a division of hints in which various arguments in favor of electricity, answers to points that are raised from time to time, and any points in the way of "ticklers" which serve to stimulate the agents' interest, are incorporated. These hints are put in a separate part of the book and are so arranged that it is clear that they are of only temporary importance.

We use the *Handbook,* or "Hint-book," as we call it, as the basis of every agent's initiation into the work with our company. As soon as an agent is taken on to the staff one of these books is made up for him, including every hint up to date. He is expected to give this careful study and to supplement the information he gains there by asking questions of his superiors. He is also sent out to learn by observation how the work is done by agents who have already become familiar with the business. In this way he ought to have a good working knowledge based upon the *Handbook,* and he can turn to the latter any time for all details that he may wish to know.

Besides furnishing these handbooks to the agents we also provide every one in the company who is interested in business-getting and keeping, with a set of the hints, thus enabling them to keep in touch with any changes that may occur in the routine of the business. Wiring contractors and dealers in electrical supplies are also given such hints of a general nature as will keep them informed and will stimulate a mutual interest in the business.

The ordinary hints are given numbers from 1 to 100; the special advertising hints are of less permanent importance and are numbered from 100 to 200, while a third series, giving prices and data in regard to current-consuming devices, has just been started and is to be numbered from 200 to 300. Of course all the numbers are not as yet in use. This division is for the purpose of making it easier to find hints on special subjects. Whenever a hint is changed the new leaf gives specific directions as to which of the old leaves are to be destroyed.

We have found that outsiders and those members of the company who do not use the *Handbook* regularly get comparatively little advantage from it. Such people often treat the new hints something as they would circulars, and put them in the book haphazard and do not destroy the old hints. The men in my department who keep their books up and are familiar with them find them very valuable indeed.

In addition, as many of our forms as possible are made of the same size as the *Handbook* leaves. For instance, when a customer signs an application, the agent may not know at the moment whether our lines are strong enough to carry his load or whether we can get the necessary pole rights to reach him.

We have a form explaining to the customer in a nice way that his signature to an application does not cover any guarantee on our part that we can reach him at any particular time. These forms are kept in the *Handbook* so that they can be easily torn out and handed to a customer when he signs an application, if it seems desirable.

Some agents who deal frequently with customers carry their *Handbook* with them all the time and keep very familiar with its contents, and these get the most advantage from it; others keep it in their desks and freshen their memory occasionally, using it more as a book of reference. Each agent, however, is held responsible for knowing all the hints and for following out their directions.

Last fall, Mr. L. D. Gibbs came on my staff to be solicitor and to do special work among the newspapers. He had never had any electrical experience, and I have thought that his experience and his opinions of the *Handbook* would be most valuable to you, so I have asked him to prepare a five-minute paper, which the secretary will read, as Mr. Gibbs, unfortunately, could not come on.

I want now to make a brief announcement of a change of plans in connection with the prize contest for the best *Agents' Handbook.* Mr. Crouse, of the Co-operative Electrical Development Association, wrote to all of those who had manifested an interest in the proposed contest last April to find out how they felt about an extension of time in which to submit the competing books. By general agreement the time was set for October 1, next, and all of the competitors must have their work turned in by that time.

I am sure you all appreciate the value of this contest to the central station because of the stimulating of interest everywhere and a fixing of the minds of a great many agents upon the details of their own handbooks through a desire to think up some way by which they could get into this contest.

I hold in my hands a New York draft for $2,600, which represents the total amount to be awarded in prizes to the successful competitors in this handbook contest. The money will be placed in a bank where it will draw interest until the time the awards are made in October, so that the winners will not only get their prize money, but the interest on it as well.

R. S. Hale

PRACTICAL EXPERIENCE WITH A HANDBOOK

I have been asked by Mr. R. S. Hale, our general agent, to sketch my experience in the use and value of the *Solicitors' Handbook.*

Upon joining the staff of the Boston Edison Company a year ago in the capacity of a publicity or press agent as well as a solicitor, my knowledge of the use of electricity or its sale was only that of the average college man with a general newspaper experience. The kilowatt had a familiar sound when rolled in an electrician's mouth, but that was all. The first thing was to learn to talk business and talk it plainly.

One of the company's complete handbooks was furnished me. In the first reading I hit only the high places. At the second reading I marked the words and sentences I did not know the meaning of, and upon reading again made a list of the remaining unintelligible points. I went over this list with others in the general agent's department and again read the book.

Reading imaginary meters, estimating demands, or studying Wright demand indicator readings and figuring possible bills came next—always supplemented by the *Handbook.*

Then came days in company with the suburban agents, watching and listening to how they do it. Much was gained by thus getting practical demonstrations of the "How" and "Why." The agents' dexterity and the nimbleness with which they jumped around among kilowatt-hours, horse-powers, reaching conclusions by deduction and induction, made me dizzy. But questions and the handy *Handbook* cleared the way to understanding, so that practical experience did not come hard.

Our *Handbook* has impressed me from the first as remarkably concise and clear. It is compressed experience and is written with a view to understanding. If studied daily it beats the *Bible* as a guide to—some kinds of—light, heat and power.

L. D. Gibbs

Chairman Freeman: There are certain features in this handbook that must be apparent to all of us. One is that such a book should be invaluable to all large companies, and the second is that the incentive to the preparation of such a handbook is what is needed in every company. I am sure nothing could be more valuable to any commercial man than to go to work and prepare such a handbook, from the fact that he would be collecting information of which otherwise he would probably have no knowledge, and would be forced to equip himself as a commercial man in working on such a handbook in a manner that could not be brought about in any other way. I think the inducements are such as to attract many of our members to enter the competition, and I am sure the handbook finally selected will be a credit to this association and a great benefit to its membership.

The following papers were then read: *Sizing Up the Territory—Preparing the Lists of Prospective Customers,* Mr. George Williams, Cincinnati, Ohio (read by Mr. W. H. Gardiner, New York); *Qualifications of Solicitors for Different Classes of Business,* Mr. Frank W. Frueauff, Denver, Colo.

SIZING UP THE TERRITORY—PREPARING THE LISTS OF PROSPECTIVE CUSTOMERS

(1) The solicitor's district is ordinarily found to contain a variety of prospects that call into use nearly all standard electrical appliances and types of lighting. If the population of the territory is exclusively resident and numbers over 10,000, this district will be of a high character of dwellings and will offer many possibilities for power and electrical appliances that would not find so ready a sale in districts composed of poorer dwellings. The latter district will contain a greater variety of possibilities because of the intermingling of stores, saloons and factories. While some districts will unavoidably produce greater revenue than others, any district can be cultivated at a profit regardless of the character of its population, class of dwellings, or nature of the commerce.

(2) The necessity of knowing who and what it is desired to sell, in advance of the attempt, is quite apparent in the sale of anything and especially true in the sale of current. The process alone of compiling the list of prospective customers will warrant the work entailed. The actual number of possibilities for various appliances and forms of lighting far exceeds the number usually closed, and we are all inclined to underestimate this or the increasing number caused by growth of population and growth of possibilities through education, so that a frequent analysis of the possibilities is advantageous, if only used to decide the plan of campaign or the provision for supply.

In an undeveloped district a hit-or-miss method may result in success, but with the progress of a campaign the importance grows for listing the possibilities systematically. As no example exists of completely developed sales, the proportion of sale to possibilities can not be precisely estimated, but there is sufficient proof that geographical location or size of city does not prevent development of sales. Likewise in the solicitor's district wherever light and power are already applied by less convenient agencies, or new uses created, it is simply a matter of locating the prospect and conveying the information of the merits of the electrical method.

The rapid improvement in electrical appliances has made electric current an easy commodity to sell and has multiplied the prospects for sale. The retailer now has ample precedent regarding the merits of electrical advertising, and the resident demands an illumination for comfort rather than bare necessity for safety.

A few years ago the name and address of house occupants might suffice for a list of prospects; now a list of a score of items can be recorded to one household and all worked on to advantage, because electricity has been applied with efficiency at a more rapid rate than the central station has educated its public.

We are apt also to underestimate the purchasing ability of the prospect. It should be remembered that in the majority of instances the same amount of money, or greater, is already being expended by the prospect for the same object with nearly every difference in favor of electricity.

If every customer possessed the knowledge of the merits and possibilities of the accomplishments by electrical application, there would be little need of solicitation or advertising, hence the importance of classifying the possibilities and promoting the intelligence in the most economical manner.

For canvassing a district, the form of a directory listed in the order of streets and house numbers, allowing for indication of equipment or possibilities of sale, is perhaps the most convenient. This book is especially valuable to acquaint the solicitor with the name and equipment, avoids uselessly questioning the prospect, and forearms him with useful information before interview. The book may be maintained by checking with office records, observance of changes of residence, and routine canvass.

A card index or tabulated list of prospects, classified by the nature of the business or class of articles for which they are desirable prospects, is a simple record for mailing lists or for solicitation by special talent.

George Williams

QUALIFICATIONS OF SOLICITORS FOR DIFFERENT CLASSES OF BUSINESS

In nearly all of the active lines of mercantile work men are being trained to follow some branch of the work, the idea being to have them specialists in some particular feature.

The solicitors or representatives employed by electric light and power companies should develop into specialists as the importance of their particular work and the distinction between different classes of business become more apparent.

In many companies now actively pursuing a new-business campaign the idea of selecting men specially trained or developed for a given branch of business has become necessary. A consumer prefers to feel he is being approached by some one who is specially fitted to advise him on the proposition he is considering.

Electric Power—A representative of a company soliciting electric power is best fitted for this work if he has a technical knowledge of steam and electrical engineering. Many of the best prospects for the electric company lie in closing down isolated plants, and the representative in his work must be able to make an intelligent investigation of the plant in order to determine any possible saving to the owner in connecting with the central station. He must be able to figure the amount of coal used under present conditions and the saving if the lighting load is taken off; also to know the difference in labor cost under both methods.

Representatives in soliciting power business, whether in large or small quantities, should have a very intimate knowledge of machinery, and should be able to analyze local conditions to determine the probable load-factor and to determine closely the cost of past operation and saving through a change to the central station. The solicitor understanding only the selling end of the business can make little headway in securing power contracts.

Sign and Display Work—The representative best fitted for this class of work is the one who can set forth intelligently the value of electric advertising and publicity. He must be able to present his proposition as one of increasing the revenue of the merchant by an advertising expenditure. His ideas must be along those of the latest advertising methods—always keeping in mind that a display made for one merchant in a given line of business is impossible for another, and therefore he must be both original and versatile. He should possess the optimism and enthusiasm of the usual solicitor for advertising.

He should know how to figure the cost of building a sign, its cost of erection and painting. He should keep closely in touch with current literature or work being done in other cities, in order that he may be able to present new methods of display. A great deal of business can be secured from merchants in the same line of business if a variety of suggestions can be given.

The representative should make a study of the relative value of various classes of advertising, and be able to show the consumer that the cost per opportunity for electric advertising is much less than any other known method.

Window Lighting—Many of the qualifications for sign and display lighting work apply here; but, in addition to those, the representative should make a study of the best classes of window dressing and have a good knowledge of decorative lighting and illuminating engineering. The solicitor should study the catalogues of all the supply houses and fixture houses, keeping in mind any new methods of reflecting or diffusing light. Variety in methods of window lighting is as desirable as it is in sign and display lighting. Many windows where a great deal of lighting is found appear badly lighted simply through a poor arrangement. The representative should study particularly along these lines.

Interior Lighting—A solicitor working on interior lighting is best qualified if he has a complete knowledge of illuminating engineering, thus knowing how to secure the best effects with the least outlay to the consumer. A solicitor without this training can accomplish little permanent result.

The solicitor should be thoroughly posted on the rates charged by his company for service under various conditions. There are many desirable opportunities for interior lighting that can be taken on by a change in the rate where the load-factor is improved.

He should have a very positive idea of the value of electricity as compared with any of the other illuminants. The activity of competing gas companies can only be overcome by an intimate knowledge of the various ways in which electricity can be applied more satisfactorily. He should make a study of all the new forms of lighting as they come out, and aim to interest his prospects in anything novel, thus gradually increasing the standard of illumination.

New Buildings—The solicitor working among builders and architects must be fully alive to all the latest forms and devices for properly wiring and equipping a building, keeping in close touch with new classes of fixtures, switches, lamps, and so forth.

He should have a general knowledge of building, so that he can advise as to when and how work should be done. Many builders have in the past let the wiring contract and paid no further attention to it, and have later been seriously inconvenienced in having to re-arrange their wiring to get best effects.

Work of Service Supervisors—The most versatile of the solicitors should be the man who works among present users. He should thoroughly understand the reason for, and method of overcoming, any kind of local trouble. He should be posted on all known devices applicable to his prospects. He should be able to present the advantages and conveniences of all the novelties that are put on the market from time to time, each of them having some value to the central station in increasing its returns from present users.

Women Solicitors—The sphere of the woman solicitor with the electric light and power company seems limited. Her greatest value would be in advocating the installation of special appliances in the home. There are, however, exceptions to the usual rule, but in most cases the woman solicitor is of little value to the company except on special work. The difficulty seems to be the belief of the consumer that a woman solicitor is not qualified to present her proposition intelligently.

Applicable to All—Every special representative or solicitor working on different classes of business must first of all be possessed of tact, a too direct presentation of the proposition often resulting in no business. Perseverance is always essential. Little or no business can be closed on first effort. Resourcefulness is also necessary. If the presentation of the argument in one way fails, try another. A good appearance is desirable. Your prospect must be pleased with your address or you will find it hard to hold his attention. Lastly, know your business. Do not make a statement unless you are prepared to prove it, and talk in a way that will inspire confidence.

Frank W. Frueauff

The meeting then adjourned until two o'clock.

SECOND SESSION

Chairman Freeman called the meeting to order at a quarter after two o'clock in the afternoon, and the first order of business was the reading of the following paper:

How to Measure Results and Pay Solicitors. Mr. Leon H. Scherck, New York city. Before reading his paper, Mr. Scherck said:

I suggest to the executive committee that in the future no papers be read at the convention. We take up too much time in reading the papers, and there is not sufficient time for discussion. I think we should get better results if the executive committee would send out these papers three or four weeks before the convention. Then we could study them and be prepared to discuss them at the meeting.

HOW TO MEASURE RESULTS AND PAY SOLICITORS

How to Measure Results—"Nothing succeeds like success," and the success of any business venture should be measured by the net returns on the amount of money invested in the undertaking. Do not understand net results—referring to those of an electric-lighting property—to mean gross earnings less operating expenses, for here lies a pitfall for the unwary. Net returns should mean net returns, and to arrive at them we must deduct from the gross earnings of an electric-lighting company not only operating expenses and such fixed charges as bond interest, taxes, and so forth, but also a fair—and a *very* fair—amount for depreciation. Here is a great, big item, gentlemen, and one that many managers of central stations see fit to overlook; especially is this true of properties operated by municipalities. But while you might overlook this very important item, there is no escape from it, and the day of reckoning is bound to come when machinery wears out or becomes obsolete.

Your operating expenses should be such as to insure the property being kept in first-class condition, and in addition to this a certain sum should be set aside to provide for depreciation.

What is left at the end of the year, after deducting from gross earnings, operating expenses plus bond interest, interest on current liabilities, taxes, and a certain amount for depreciation as well as a fair rate of interest on the real amount of money which has been put into the stock, represents to me the net results and the measure of success for the year under consideration.

It is easy enough in any growing community to increase the gross earnings of your property, but it is not so easy to produce results commensurate with the investment. Capitalists are entitled to a certain fair profit for putting their money into an electric-light plant, and after all items of expense are considered and a fair interest allowed on all real money invested, there should be an additional amount left which we call profit. Profit arrived at in this way is the measure of your work.

Now, it is logical to pay the people who bring in new business in such a manner as to encourage only profitable business and discourage the opposite kind.

How to Pay Solicitors—I believe that solicitors for electric-lighting and power companies should be paid a fair salary, sufficient at least to cover living expenses, and in addition to this a commission to be based upon the net returns of the business that they have brought in; but I would allow a commission only on new business that remained on the company's books for a certain length of time, say at least six months, and would base this commission upon two things: First, the revenue for the new business for six months (referring to the new business brought in by the solicitor) in excess of a certain amount; second, the revenue for this new business for six months in excess of a certain amount per kilowatt demand. The commission thus determined should be allowed but once, and only to those solicitors who are with the company at the time the commission is compiled. Just what the percentage commission should be and what the fixed amount in excess of which the commission should be allowed, will have to be worked out by each company, and even varied for different districts of the same city, as of course a larger percentage commission and a less fixed amount should be allowed in those districts in which business is hard to secure.

I believe, too, that the amount of commission to be allowed should be limited so as not in any case to exceed the salary of the solicitor, in order to protect the company against excess payment to solicitors due to any unusually large business which, while credited to the solicitor, might not in reality be due to his efforts. In addition to the commission on new business I would recommend that at the end of every six months or year a certain bonus be allowed the solicitor on all old business retained on the company's books through his individual efforts. This in order that time spent in holding old business—perhaps more important than securing new—should not go unrewarded.

Most central-station managers who allow a commission to solicitors base this commission upon the connected load, and by those with whom I have spoken on this subject the claim is made that while they acknowledge this method of payment is not equitable yet they have adopted it on account of its simplicity. I claim that this method of payment to solicitors is entirely wrong from its very nature, as you encourage what in reality amounts to false returns. You are not or should not be looking for a big connected load; what you want is a paying load, and it seems to me, therefore, sensible to pay on an equitable though somewhat complicated basis rather than on an inequitable though simple plan.

The method that I advocate, though not as simple as the one in general use, can be worked out so as to be practicable and is somewhat as follows: On January 1 we will consider the new business brought in by the solicitor for the months of June, July and August; on April 1 we will consider the new business brought in by the solicitor for September, October and November; on July 1, the new business for December, January and February, and on October 1, the new business for March, April and May. The solicitors would then be paid a commission every three months, this commission based upon the two items that I have mentioned above. Those solicitors not with the company at the time of compilation would not be entitled to any commission, and new business not on the books at the time of compilation would not be considered, for the chances are that the business that is on your lines for less than six months, everything considered, has not allowed the company much profit; though perhaps there are exceptions to this rule; for instance, business dependent entirely upon the seasons, such as fans, and such business could be considered separately.

Perhaps the method suggested above will seem to many as entirely too complicated a proposition, but all of us know that there is no very easy way of doing things well, and I think it is cheaper to hire a clerk or use up part of a clerk's time to do the necessary clerical work, if by doing so we put into practice a plan whereby we encourage only profitable business.

Leon H. Scherck

Mr. J. D. Kenyon, vice-president of the Sheldon School, Chicago, then read the following paper on *Education of the Salesman:*

EDUCATION OF THE SALESMAN

It is almost past the power of the imagination to realize what wonderful advancement has been made in the commercial world during the last two centuries, and particularly the last. It is almost beyond belief as we look around us and see the vast business enterprises, beautiful buildings towering into the skies, swiftly-moving trains and ships, the vast volume of business that is transacted daily, the comforts, conveniences and luxuries of civilization—I say it is almost impossible to realize that about 400 years ago this vast country was peopled only by savages whose sole knowledge of electricity was the lightning flashes in the heavens. If even Lincoln could come to life to-day he would undoubtedly be speechless with surprise at the wonderful things that he would see everywhere, and certainly would be could he visit the beautiful display at this convention. It is almost beyond imagination to realize that it is only about 100 years since Franklin's kite was sent up into the clouds and down the slender cord attached to that kite came the first shock of harnessed electricity, which now is being chained to and moving the wheels of commerce, sending messages over the land and under the sea, lighting our homes for us and in thousands of ways doing service for mankind, even prolonging life itself when disease strikes at our vitals.

Can we realize, as we look around us, that it was only about 30 years ago that the first practical application of electricity was made when Brush's light was first put into use? There is forced upon our consciousness the question, "How is it possible that such wonderful things have been accomplished?" And the answer must be that Science has lighted the way with the lamp of knowledge. Science is but organized knowledge, and as men discovered laws and principles and tested them, understood their relations to each other, Science was born. And so from the time Franklin's kite went soaring into the clouds to the present time the minds of many of the ablest men have been centred upon the discovery of the natural laws of electricity and the application of these laws to the needs of mankind. As we look around us, it seems as if man must have arrived at almost a state of perfection; and yet we know that is far from true. We are yet at the very beginning of our knowledge of this science, but the fact does remain that it is true of electricity and its application as it is true in commercial propositions of all kinds, that the advancement in the production of appliances for its use is far in advance of the methods of selling them. In other words, the production end of business generally is more nearly perfected than the selling end.

One of the greatest problems, if not the greatest problem, confronting you gentlemen to-day, is the perfection of the selling organization, because in this day of strenuous competition you can not sit down and wait until the public hands you orders on a silver platter. You must go out in the highways and byways and seek the business. Where would you gentlemen be in the production end of this great branch of business were it not for the science of electricity, the knowledge that many men who have devoted their thought and energy to the discovery of those natural laws organized in such shape that it could be mastered and understood? Where would you be, in other words, but for your electrical engineers? And, I say, where are you going to be if you do not have engineers of salesmanship—if you allow the expression?

It is becoming more apparent every day that there is a science underlying salesmanship, and that there is a necessity for men engaged in that line of business to master this science so that their knowledge may be increased and their skill become greater every day through the understanding of and operating in harmony with the natural laws governing the sale of goods. There is a cry constantly going up for men of ability in this direction—men who have the power of persuasion, men who not only know how to get business, but to build business. Every concern has an opening for a man who is really a salesman, but the supply is very limited. The man who is skilful is already employed, and he is too much interested in his work, as a rule, to be looking for other positions. Managers can not sit and wait for good men to show up; they must take the best they can get and see that they are trained—trained scientifically. The electrical engineer knows all about the different parts of machinery that is used in connection with electricity. He knows how such machinery is put together; how it operates; how to connect the wires; how to turn on the power; how to generate that power. So the salesman must become familiar with all the elements that enter into the power of persuasion. He must understand them logically, he must understand what the power is, what generates the power, how much of the power to turn on and when to turn it off. It will be my pleasure to outline for you a few ideas that experience has taught to be the most practical and profitable line of study and research yet discovered for the development of ability to get business and build business. In the brief time allotted me it will be impossible to go into this subject at any length, and so I will only be able to touch the high places, as it were.

The salesman must first understand himself as far as possible; know what his powers are, how to train the undeveloped powers and how to apply them. Self-knowledge is, and will always be, the most important element entering into salesmanship. Next, the salesman must understand people—human nature. He is not dealing simply with mechanical details; he is not dealing with inanimate objects wholly, but he is dealing particularly with human minds, and his mission is to convince or persuade the minds of others to agree with him. And third, he must have a knowledge of his goods. The more thorough that knowledge, the better, and yet it is true that a man may be thoroughly posted on all the technical details of the goods which he is handling, and yet be so unable to explain these to others that he will be a failure as a salesman. So let us for the moment go back to the first proposition, the salesman himself, and see what is the source of his power.

We find at the start that his ability to inspire confidence is one of the most important elements entering into the question. Upon analysis it is found that the ability of the salesman to inspire confidence rests primarily on his personality; that personality is the result of the visible expression of character and health. By character I do not mean simply being good. There are lots of good men, men who are too good to do much evil, but who have only a wishbone instead of a backbone—they lack force. Character means something more than being good. It is the result of the development of the positive qualities and faculties of the mind. Let us see the result of these positives.

In electricity you are familiar with the terms of positives and negatives, and there are positives and negatives running all through the physical, mental and moral man. We all know that the successful man must be a thinking man. In order to be a thinking man he must possess the positive faculties of perception, of memory, of reason and judgment, of imagination, of concentration, of will-power. The negatives of these faculties are obtuseness, forgetfulness, unreasonableness, injudiciousness, dullness, inattention and indecision. We can train any muscle by physical exercise, and it is equally true that we can train any faculty of the mind by mental exercise. If we want to get rid of the physical negative of weakness we do so through exercise, building strength. If we want to get rid of the mental negative of dullness, forgetfulness, indecision, inattention, and so forth, we do so by exercising the positive mental faculties.

While our ordinary business experience does to some extent give us exercise both physical and mental, yet it is true that it is not symmetrical exercise; that it is not thorough; that it is but one-sided and unsystematic. If the athlete expects to win in a contest he trains scientifically. He does not depend upon his natural forces and the development he would get in natural pursuits. So we in the business life must consciously train the faculties and qualities that are brought into play so that we can improve natural conditions and intensify our power. It is not enough for a man to cultivate the physical powers and the thinking powers, but he must cultivate the feeling powers, such as faith, ambition, courage, loyalty, love. The negative of faith is doubt, and doubt has killed more successes than all the armies of the world have killed men. Let a man doubt himself, his firm, his goods, or the customer, and he can't help but show it in every move he makes. But a man of faith is the man who convinces. Instead of apathy, which too often exists, resulting in the satisfied condition of letting well enough alone, there should be the ambition to become an expert—an expert among experts.

More love is needed in the business world, more brotherly love, more sunshine instead of the pessimistic, sour atmosphere that surrounds so many men endeavoring to sell goods. More loyalty is needed, because as a direct fruit of it springs the proper spirit of co-operation, enthusiasm and love which begets success.

Many a man who otherwise showed great talent has gone down to defeat simply because he did not appreciate the great law involved here, that loyalty and love go hand in hand and are assets of the greatest importance.

So, gentlemen, the scientific salesman of to-day realizes that he must not trust to natural conditions, or to the natural development that will come from ordinary contact with the world, but in order to succeed and meet the strenuous competition of modern times, he must be a trained man, and he will realize that by training the physical man along the lines of correct thinking, exercising, breathing, eating, drinking, bathing, relaxing and recreation, he will be able to build and maintain health, resulting in endurance. The world needs men who possess endurance to a marked degree, the ability to go into the game and stay there. The scientific salesman also realizes the necessity for training the intellect or thinking forces by conscious, systematic exercise, resulting in more ability. The scientific salesman also realizes the necessity for conscious training of the feeling powers, resulting in reliability. And he also realizes the necessity for training in the same way the will-power, resulting in action. Give me a man who is training himself systematically and scientifically along the lines of endurance, ability, reliability and action, and I will show you a man, all things considered, who will outdistance his competitors. This man will realize beyond the training of these faculties and qualities—which is the eductive or first part of education—that he must also fill in with useful knowledge, which is the second part of education. Thus this man will make a scientific study of human nature his business. He will study types, temperaments, motives, habits of people. He will realize that it is a great mistake to handle everybody alike. While we all belong to certain types, yet no two people are constructed exactly alike. An ability to read his fellow man correctly is one of the greatest assets of the business man. While it is true that we pick up much knowledge from contact with our fellow man, it is also true that some of the greatest scientists in the world have spent their lifetime in a masterful study of this problem, and as a result of their study have been able to give us information that will remove our knowledge from the plane of guesswork to that of practical certainty. Once knowing how to read people through the study of types, temperaments, and so forth, as evidenced not only by their general shape of head, facial expression, but through the voice, through the gesture, through habit as evidenced by many things, we shall be able to obtain a mastery of the situation.

We now come to a very important part of the salesman's knowledge, and that is the detailed knowledge of his profession. A man, to convey a correct impression to another mind, must possess a good knowledge of a subject himself. We simply transfer mental pictures through the medium of speech, of gesture, and so on. If our own impression is a poor one, we can not transmit a good one. A man with a poor knowledge of the selling points of any proposition can not fail to be a poor business-getter and a poor business-builder. He may make a spurt here and there by means of a combination of circumstances, but he will not last. Therefore the necessity of training along the lines of acquiring all the knowledge possible in reference to the goods sold. In order to do this correctly the mind of the salesman must be analytical. He must be able to analyze his proposition and put his knowledge into selling points that will prove effective. But it is one thing to know these details and another thing to express them in a way that will convince. He must in explaining the selling points place them in the proper sequence or arrangement so that the mind of the prospective customer grasps these points and is able to follow him and be enthused by the natural growth or development of the points brought out.

An important point next comes in. The salesman must not only know the proper sequence of points, but he must study the methods of expressing these points, by clothing them in proper language to fit the customer, by the use of his voice, by gestures, attitudes, and so forth. Some men talk so fast that it is impossible for minds that act slowly to grasp their ideas. Others make the mistake of talking slowly to people whose minds act quickly and who lose patience. In some cases very simple language should be used, the voice should be very low and smooth; in some instances little need be said, in others, much. The salesman must have his points so marshalled that he will be able to use them when occasion demands as a general marshalls his troops at strategic points. And finally, a salesman, to become scientific, must have knowledge of at least some of the natural laws by which the mind is governed. For instance, he must realize that in order to persuade a customer to purchase goods there are four steps through which the mind of the customer must pass before the deal is closed. The first step is attention. If he does not get the mind of the customer to concentrate on what he is selling he is losing time. The next step is interest. If the customer does not become interested, there is nothing doing. But there is another step, and that is desire. The customer must be made to want the goods. Still there is nothing doing unless the customer arrives at a decision to buy. Even here the salesman can make a mistake if he is not able to detect this stage (which is the so-called "psychological moment"), and deliberately talk the customer out of the sale. It is true that just as many sales are lost by over-talking as by under-talking. The mind operates in obedience to certain natural laws. There has been during the last few years a wonderful amount of research in the study of psychology, and many of these laws have been made so plain that we as business men can understand them and work in harmony with them and achieve success. The student of salesmanship will realize that the law of non-resistance is of vital importance; that the law of the positives is a vital one; that the law of confidence is a vital one; that the law of mutual benefit is a vital one; that there is more in business-building than in business-getting, and that he must be on the square; that it must be on a basis that pleases the customer, because salesmanship is the power to persuade others to purchase goods on a basis that is not only profitable to the institution but is permanently pleasing to the customer. The student of salesmanship will also realize the necessity of widening his general knowledge of business principles in the various departments of commercial life. He will become, to some extent at least, a student of advertising, of credits, of costs, of system. These are all points which must challenge the attention of the seeker of business success, so that he can adopt plans for development and thereby at once do more to increase the assets of the company than any other one thing he can do. It has been proven that the individual can not be left to undertake work of this kind on his own initiative. Here and there you will find a man who has enough initiative, but they are too few. It has been demonstrated that employers who realize that education is a necessary factor in their business and who institute methods of co-operation with their employees have made it pay better than any other outlay of time and money. In this way they not only secure infinitely greater results in the way of immediate business, but secure that harmonious action so essential to the highest development of the business. One of the greatest slogans of to-day is "co-operation." In harmonious action in education will come the true and permanent success of the future. The management must themselves encourage, financially and morally, methods of study, and this study not only benefits the sales department, but every department of business.

Those in control of the business should also participate in these studies; classes for study should be organized in which they meet with their men, thereby getting a more wholesome respect for each other and a general inspiration that can not but be uplifting. This is the greatest way in the world to encourage that love and enthusiasm for the work and the institution and for the dignity of the profession in which they are engaged, because it is as much of a profession as any of the other so-called professions. Employers must be willing to spend money to get such results. They have spared no money or expense in the production end of their business to perfect it, and now their greatest opportunity lies in expenditure and personal co-operation in the educational department for the development of the efficiency of salesmen, office men, and, in fact, the employees in every department. They must be willing to reward proportionately the development shown in increased results on the part of the individual. Then will follow true progress, based upon the law of mutual benefit.

The organization as a whole is a composite salesman—everybody working for it is engaged in a work the object of which is to convert goods into profits. Therefore, what an inspiring sight to see the management going hand in hand with the employees, encouraging constantly this uplift of the individual and the organization, all working harmoniously in the true spirit of brotherly love, singing the songs of labor and of love! It is through such methods that the problems of the day will be solved, the difficulties of labor will vanish. "The age wants more large-hearted, manly men; the age wants heroes—heroes who dare to stand and struggle in solid ranks of truths."

J. D. Kenyon

CHAIRMAN FREEMAN: We are greatly indebted to Mr. Kenyon for his valuable contribution to our deliberations. We have a few moments for the discussion of the papers by Messrs. Williams, Frueauff, Scherck and Kenyon.

DISCUSSION

MR. GARDINER: There is just one point that it seems to me has not been sufficiently brought out in these papers, and that is the other fellow. Size up the other fellow. See what his resources are, what his methods are, what his points are, then contrast them with your own. If we do that we get a broad conception of all the facts in hand, and we can push our own business much more effectively, and secure the upbuilding of our own business in fields that he perhaps can not enter so well as we can.

MR. E. N. WRIGHTINGTON (Boston): I would bring out a point in connection with the payment of solicitors. I believe thoroughly in paying solicitors on a commission basis. I think it is the only way to get good results. It offers that direct financial incentive that the average salesman seems to need in order to get the best results. I think, however, that the usual method of forming a basis of commission on the amount of sales that may be made of certain appliances, or on the increase in net revenue, has some inherent defects. Prominent among these is the question of the salesman's territory—the fact that one territory is in a more profitable section than another. That difficulty is sometimes insurmountable, but it seems to me that it can be partially overcome by forming the basis of the commission in a somewhat different way. Suppose the commission is to be based on the increase in revenue. Instead of taking the increase of revenue in the man's particular district or territory, provide a fund that will represent the increase in revenue for the whole company, or net increase in revenue. Apportion that fund among the salesmen according to the percentages of increase in their own territory; not upon the actual increase in dollars and cents, we will say, over the previous year, but upon the percentage of that increase. In other words, take all the percentages of increase throughout the various districts, and then give to each salesman the percentage that his percentage bears to the total. In this way, if one salesman is able to double the output in one territory, and another salesman is able to double the output in his territory, then, though in one case the amount is a great deal smaller than in the other, they will both share equally in the commissions.

Advertising

Chairman Freeman: There is no more healthful agent in our business than the art of advertising, and we are to have the privilege now of hearing and seeing the presentation of an advertising exhibit from the representative of one of the most progressive advertising companies.—Mr. C. W. Lee, of Newark, N. J.

A REVIEW OF PUBLICITY METHODS

[The convention hall was darkened for Mr. Lee's talk, and in order to facilitate the progress of the programme the speaker only displayed a portion of the lantern slides that had been prepared.

In opening Mr. Lee told a story to illustrate central-station conditions. He said, in part:]

Pat had just come over from his native land, and was visiting his brother Tim in Colorado. Tim's vocation was that of fireman on one of the mountain roads. In order that Pat might see some of the beautiful scenery and learn more of the country of his adoption, Tim had him ride on his engine over one of the mountain divisions. Seated in the cab on the high cushion, Pat watched the foothills recede as the engine with its train plunged into the recesses of the mountains. One moment he could see hundreds of feet below, through scrubby pines and quaking aspens, the green valleys, then they would plunge between towering boulders, swaying from side to side, Pat clinging to his seat with difficulty. Around a sharp curve rushed the train. The black, yawning mouth of the tunnel loomed in view directly ahead. Pat gasped. Tim yelled out above the roar of the train, "What's the matter? Don't you enjoy it?" "Oh, it's grand, it's grand!" exclaimed Pat, "but for hivin's sake, Tim, don't miss that hole!"

The successful central-station train to-day is running on the track of judicious advertising, coupled with intelligent soliciting. Beyond the tunnel of business vicissitudes lie green fields of increased earnings and substantial dividends. Now, my appeal to-day to you—men representing the commercial end of a great industry—is not to miss the hole.

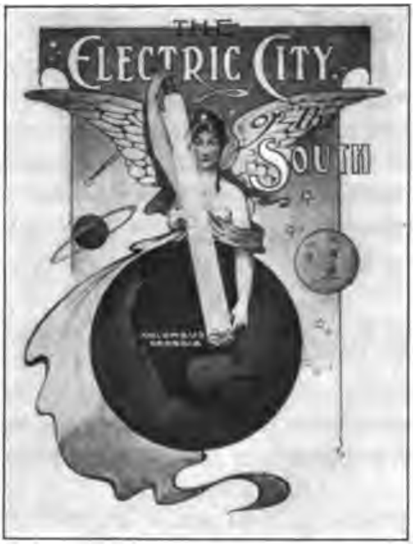
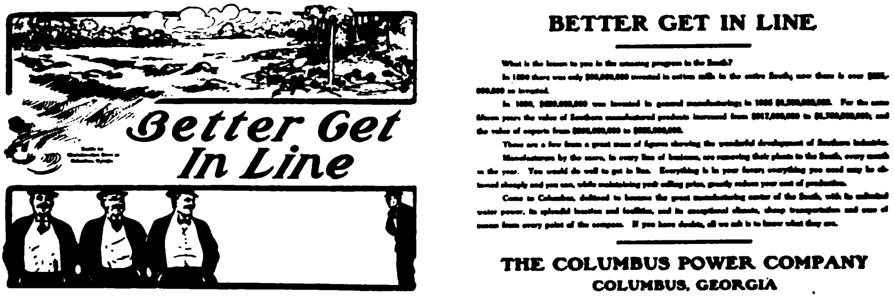


Fig. 1—Booklet Cover Design

Results—substantial results—is the demand made upon every commercial department. Your directorate do not care how these



Better Get In Line

BETTER GET IN LINE

THE COLUMBUS POWER COMPANY
COLUMBUS, GEORGIA

Fig. 2—Folder Used in Power Campaign

results are obtained. They only insist that they shall be secured with the least possible expenditure.

Several weeks ago I received an urgent appeal from Mr.

Lüpke, the esteemed editor of the *Question Box*. He feared that the advertising section of the *Question Box* would fall flat unless more answers were secured. After a careful perusal of the questions, I was assailed by the thought, "Have all of our educational efforts been in vain?" Here are two of the questions:

If you had an advertising appropriation of from five to fifteen thousand dollars, would you spend it in the street cars or the newspapers?

With an adequate new-business appropriation, would you expend this money for solicitors or advertising?

These questions struck me as being about as inane as the time-worn query: "Which would you rather do or go fishing?"

Thousands of dollars are being expended foolishly each year on central-station advertising. I venture the prediction that within the next two years syndicate advertising, as applied to central stations, will have passed out. By syndicate, I mean the preparation of stock campaigns or copy, which, in the past, have been made to apply to all classes of central stations. We are living in an age of specialists, and the advertising specialist is essential to any live central station.

To be true to the best interests of his clients, the commercial engineer or specialist must make a careful study of local conditions, then plan the campaign and copy to fit these conditions, working at all times in harmony with the soliciting force. The solicitor is the first requisite for a new-business department, but he can be materially strengthened in his work through plans laid out by the advertising specialist.

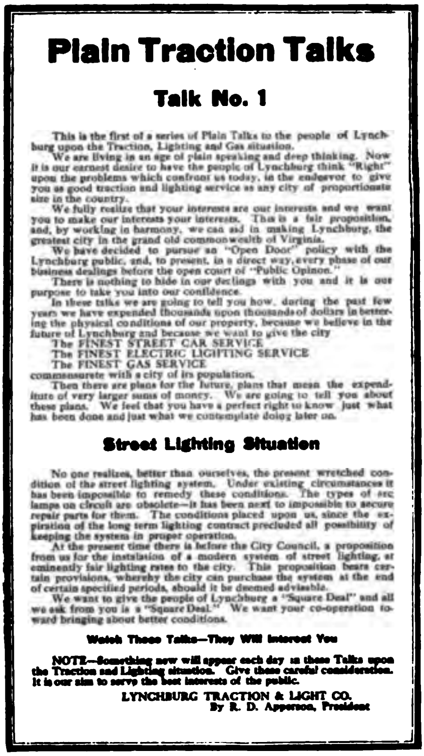
One lighting company that I have in mind, after three years of successful follow-up methods, killed the advertising appropriation this year and nearly doubled its soliciting force. The business has fallen off under this plan, and the directors now realize the folly of discontinuing their advertising.

All new-business efforts are accumulative in results, and to get these results you must everlastingly *hustle, hustle, hustle!*

Within the time allotted during this crowded business day it would be impossible to show complete advertising campaigns. However, I have prepared a number of slides which will give the commercial men present some idea of successful central-station advertising and publicity methods.

[Slides were shown of a number of successful bulletins and pieces of advertising matter, as well as letters, in a number of direct-by-mail campaigns that had been successful in cities from 10,000 population to a million. Figures of results obtained were given, and covered power, store and window-lighting and residence campaigns.]

It is a popular fallacy among central-station managers that newspaper space possesses little or no value. Within the past two years it has been demonstrated by many central stations, large and small, that the columns of the local daily press can be used to advantage in advertising the wares of the central station. The value of newspaper space is determined by the copy used. More and more our electric companies are depending upon the newspaper to achieve results. The examples shown of newspaper



Plain Traction Talks

Talk No. 1

This is the first of a series of Plain Talks to the people of Lynchburg upon the Traction, Lighting and Gas situation.

We are living in an age of plain speaking and deep thinking. Now it is our earnest desire to have the people of Lynchburg think "Right" upon the problems which confront us today, in the endeavor to give you as good traction and lighting service as any city of proportionate size in the country.

We fully realize that your interests are our interests and we want you to make our interests your interests. This is a fair proposition, and, by working in harmony, we can aid in making Lynchburg, the greatest city in the grand old commonwealth of Virginia.

We have decided to pursue an "Open Door" policy with the Lynchburg public, and, to present, in a direct way, every phase of our business dealings before the open court of "Public Opinon."

There is nothing to hide in our dealings with you and it is our purpose to take you into our confidence.

In these talks we are going to tell you how, during the past few years we have expended thousands upon thousands of dollars in bettering the physical conditions of our property, because we believe in the future of Lynchburg and because we want to give the city

The FINEST STREET CAR SERVICE
The FINEST ELECTRIC LIGHTING SERVICE
The FINEST GAS SERVICE

commensurate with a city of its population.

Then there are plans for the future, plans that mean the expenditure of very larger sums of money. We are going to tell you about these plans. We feel that you have a perfect right to know just what has been done and just what we contemplate doing later on.

Street Lighting Situation

No one realizes, better than ourselves, the present wretched condition of the street lighting system. Under existing circumstances it has been impossible to remedy these conditions. The types of arc lamps on circuit are obsolete—it has been next to impossible to secure repair parts for them. The conditions placed upon us, since the expiration of the long term lighting contract precluded all possibility of keeping the system in proper operation.

At the present time there is before the City Council, a proposition from us for the instalation of a modern system of street lighting, at eminently fair lighting rates to the city. This proposition bears certain provisions, whereby the city can purchase the system at the end of certain specified periods, should it be deemed advisable.

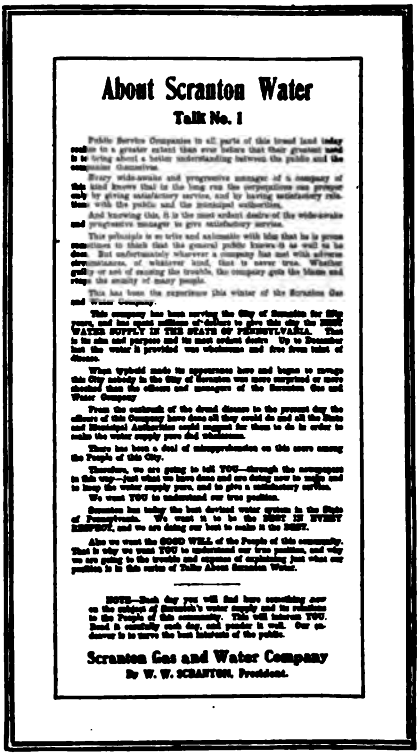
We want to give the people of Lynchburg a "Square Deal" and all we ask from you is a "Square Deal." We want your co-operation toward bringing about better conditions.

Watch These Talks—They Will Interest You

NOTE—Something new will appear each day in these Talks upon the Traction and Lighting situation. Give these careful consideration. It is our aim to serve the best interests of the public.

LYNCHBURG TRACTION & LIGHT CO.
By R. D. Apperson, President

FIG. 3—NEWSPAPER ADVERTISEMENT



About Scranton Water

Talk No. 1

Scranton Gas and Water Company
By W. W. SCRANTON, President.

FIG. 4—NEWSPAPER ADVERTISEMENT

copy have been selected at random. The combination of proper design and right copy will rivet the attention of the reading public.

In these days when the public-utility companies are being roasted on the griddle of public opinion, it is an encouraging sign to discover that the lighting company and municipality, whose interests are practically identical, can work together in the utmost harmony in the upbuilding of the community.

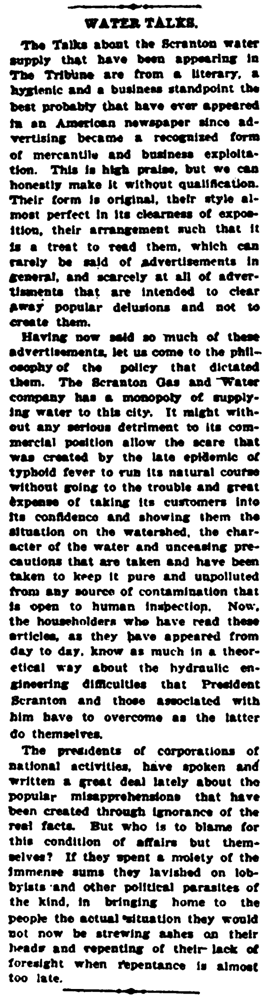
In a southern city there is located a company which, besides a present water-power development of 12,000 horse-power, has under way a prospective development of 40,000 horse-power additional. This company combined forces with the local board of trade and the city in the preparation of an advertising campaign, outlined to draw industries to the city. Magazine copy and news-publicity methods were used in the initial work, and to-day a follow-up campaign directed to a large list of northern manufacturers is being sent out by the power company.

The Savannah Electric Company has followed in the wake of the Columbus Power Company in an endeavor to co-operate with the city in an industrial way. Its newspaper copy is of a semi-publicity nature.

There is great need at this time for public-utility companies not only to secure but to retain the good will of the community which they serve. The question of corporation control has been relentlessly sweeping the country and has forcefully attacked the lighting companies. No better medium of changing community sentiment can be used than the display columns of the local newspapers. Alert, keen and far-sighted newspaper men with the proper viewpoint toward corporations, and under conservative direction, must be employed to successfully conduct campaigns of this character. Where this is done, truly marvelous results can be secured.

In the city of Roanoke, Va., where stiff competition had been encountered in the lighting department, public sentiment was strong against the Roanoke Railway and Light Company, owing to the torn-up condition of the streets. A campaign was conducted for a period of 90 days, copy being changed daily, and at the end of that period a transformation had come over the community. To-day the company is building a new station to take care of the rapidly developed business.

Lynchburg, Va., has been in the centre of a wave of municipal control, and not until publicity methods were adopted did the city council come to its senses. A long-term street-lighting contract was recently executed with the Lynchburg Traction and Light Company, and the municipal-ownership bug is dead in that community.



WATER TALKS.

The Talks about the Scranton water supply that have been appearing in The Tribune are from a literary, a hygienic and a business standpoint the best probably that have ever appeared in an American newspaper since advertising became a recognized form of mercantile and business exploitation. This is high praise, but we can honestly make it without qualification. Their form is original, their style almost perfect in its clearness of exposition, their arrangement such that it is a treat to read them, which can rarely be said of advertisements in general, and scarcely at all of advertisments that are intended to clear away popular delusions and not to create them.

Having now said so much of these advertisements, let us come to the philosophy of the policy that dictated them. The Scranton Gas and Water company has a monopoly of supplying water to this city. It might without any serious detriment to its commercial position allow the scare that was created by the late epidemic of typhoid fever to run its natural course without going to the trouble and great expense of taking its customers into its confidence and showing them the situation on the watershed, the character of the water and unceasing precautions that are taken and have been taken to keep it pure and unpolluted from any source of contamination that is open to human inspection. Now, the householders who have read these articles, as they have appeared from day to day, know as much in a theoretical way about the hydraulic engineering difficulties that President Scranton and those associated with him have to overcome as the latter do themselves.

The presidents of corporations of national activities, have spoken and written a great deal lately about the popular misapprehensions that have been created through ignorance of the real facts. But who is to blame for this condition of affairs but themselves? If they spent a moiety of the immense sums they lavished on lobbyists and other political parasites of the kind, in bringing home to the people the actual situation they would not now be strewing ashes on their heads and repenting of their lack of foresight when repentance is almost too late.

FIG. 5—EDITORIAL FROM SCRANTON "TRIBUNE"

As all utility companies are on the same plane in reference to municipal control, it will not be amiss to touch hurriedly upon the publicity methods that were recently adopted by the Scranton (Pa.) Gas and Water Company. In this city a typhoid epidemic had raged for two months, there had been 1100 cases of fever and 110 deaths. The newspapers printed columns about the pollution of the water supply, charging the company with untold crimes. The matter assumed national importance through attacks made by *Ridgeway's* and *Collier's* magazines. Within 40 days, through the proper publicity methods, the sentiment against this company was changed.

[To show what this change meant, the speaker read an editorial appearing in the Scranton *Tribune* (see Figure 5).]

[Mr. Lee had projected upon a screen lantern slides illustrative of various forms of advertising literature used by the electric light companies throughout the country.]

CHAIRMAN FREEMAN: You will agree that this exhibit has not only been interesting and helpful to us, but it indicates the scope of these advertising campaigns, and the practical results obtained. I am sure that the preparation of this review has cost Mr. Lee a great deal in money and in effort. Our thanks are due to him, and I am sure you will authorize me to tender them in your behalf.

The following papers were next presented: *Advertising Results Demonstrated,* Mr. E. S. Marlow, Washington, D. C.; *How to Make the Most of Newspaper Advertising,* Mr. A. D. Mackie, Peoria, Ill.; *Measuring the Results of Advertising,* Mr. M. S. Seelman, Jr., Brooklyn, N. Y.; *The Value of the Service of the Advertising Agency or Specialist,* Mr. Lawrence Manning, Owosso, Mich.; *Display-Room and Demonstration as Business-Getters,* Mr. E. R. Davenport, Providence, R. I.; *New Business by Indirect Methods,* Mr. L. D. Mathes, Dubuque, Iowa, and a paper on the same subject by Mr. George Steinwedell, St. Paul, Minn.

ADVERTISING RESULTS DEMONSTRATED

Before giving to the association a report of information secured regarding the subject which forms the title of this paper, your reporter desires to make particular mention of the very short time which ensued between the notification of his assignment to this work, namely, April 25, and the date when it was necessary to complete the report so as to be ready for presentation, namely, May 21.

The success with which your reporter met can be very well judged by the following:

The question of "advertising results demonstrated" is certainly a very important one to central-station officials. Because of its importance your reporter states with regret that out of 47 requests for information he received but 10 replies, only a very few of which contained information that would lead one to believe that a systematized effort had been made to keep track of results and thereby in a measure ascertain the relative value of different media as applied to the conditions that exist or will arise.

Of course there are some forms of advertising from which it is practically impossible to trace direct results, such as newspaper, billboard and street-car advertising, but as a majority of the companies that advertise make use of the direct-by-mail method it seems that at least a part of the results can be traced, which would help the advertising manager to judge the best pieces.

As a further evidence of the apparent lack of interest in this subject, your reporter quotes the following extract from a paper read before the Association of Edison Illuminating Companies at its convention in 1906:

"If advertising is worth anything it should certainly be worth while to keep a record of the traceable results; and yet only three companies kept records of replies received to advertisements and contracts closed as a result therefrom."

As the members of this association represent companies located in towns and cities of different sizes, it does not seem that justice can be done to all concerned or to the subject by reporting on a very few cases that would in all probability be of value to but very few companies. Therefore your reporter will devote himself to urging upon the association the great necessity of each company keeping a systematic account of the traceable results from its advertising and reporting to a duly appointed committee of the association such information as its advertising department is able to obtain in that direction. It certainly seems that the work of such a committee would relatively be as valuable as the work that has already been accomplished by committees appointed to investigate things regarding the generation and transmission of current which are of great importance.

The value of an advertising manager of ideas and good business instincts is fast becoming appreciated by the officials of central-station companies and by persons financially interested in them, and it is not going too far to say that the results of his work should be made a matter of close record by the association to the same relative extent as the results obtained in any other branch of the business. Such a record would enable executive officials to determine more accurately what proportion of the company's gross revenue should be spent in the exploitation of the merits of its product through regular advertising channels, also the proportional amount that should be set aside for each form.

As it is generally conceded that the advertising manager's work is to a great extent an experiment to discover what in detail will be the very best way to spend the money which the company employing him places at his disposal, really valuable information on the subject of traceable results would tend to eliminate a great deal of the "hit or miss" from his efforts. Such information can be obtained only after the various companies of this association have applied themselves to the work of keeping a rigid account of the direct replies received from each piece of advertising matter sent out, the contracts closed as a result, the value of the business thus received, and the net expense of securing same.

Your reporter suggests that the various members take this question up individually and that they endeavor during the coming year to keep an account of the results which they are able to trace, so that a committee—if one be appointed to investigate, or if not, the reporter on this subject for the next convention—may be able to give information of a tangible nature when the matter is again presented.

Your reporter would also suggest that the questions be framed and submitted as far in advance as possible, as the various advertising managers would then have an opportunity to answer in a fairly definite way, and the report on the subject would form a guide for future advertising investments.

E. S. Marlow

HOW TO MAKE THE MOST OF NEWSPAPER ADVERTISING

The whole structure of the commercial world to-day rests on advertising. Great corporations that a few years ago conducted their business from dark rooms to-day realize that they must turn on the light of publicity—take the public into their confidence, show them there is nothing up their sleeve—if they expect to pay dividends. Confidence begets confidence, and what greater dividend-earner can there be for any public-service institution than the confidence of the public with which it does business?

It is but a very few years since electric companies began to realize there was anything in the advertising business for them. These commodities counted as necessities, and the philosophy of the average manager was that anything which the people had to have did not need advertising. Then, again, most corporations manufacturing electricity had a monopoly on the commodity in their respective localities; this was another reason why advertising was considered unnecessary. True, a few companies contracted for a certain amount of space in the newspapers and probably left it to the advertising manager of the newspaper to supply the copy, changing it about as often as the contract was renewed. This was done less with the thought of getting returns from the advertisement than as a matter of policy.

Finally, the real advertising germ reached the central-station manager, and here and there the disease began to crop out, and then like any really contagious disease it spread and developed until to-day (to make a long story short) many electric companies are among the largest users of advertising space to be found anywhere.

All this is prefatory—the important point with any advertiser, and the subject of this paper, is "How to get the most out of advertising."

This age is one of progression. There is no standing still—it is either forward or backward. We have arrived at a time when thinking is an art; to attempt to get business by the simple old methods is like turning in a fire alarm after the building is burned down.

An advertising man must think—he must think quickly and logically—he must put his thoughts into convincing words, and the briefer, the better; just enough subject matter to attract the eye and stick in the memory of the reader—apt sayings—attractive phrases—fresh and catchy headlines should be added day after day.

Bear in mind that the public is busy and has many self-interests. It is not going to search through the papers for your advertisement. It, therefore, behooves you, Mr. "Ad. Writer," to make your newspaper talks short, sharp and to the point, so that upon the paper being opened your advertisement stands out and catches the eye. This does not necessarily mean large space, but it does mean plenty of white space and plain black type with a bold headline or two, and then your subject in a few "to-the-point" sentences written as you would speak them to cover some individual case. A clear, attractive cut bearing on the article advertised is always good. If you have no competition in your town or city, the company name may be left off.

The electric business is not like the dry-goods business, where competition is keen, and John Brown, Henry Smith and Jake Jones are all selling dry goods. There John Brown must not only advertise the fact that he sells dry goods, but also the fact that John Brown's is the right place to buy dry goods. The central station sells electric energy, and that should be the key-note. Whether that energy be used in connection with a curling-iron heater, an electric iron, a sewing-machine motor, an electric fan, an electric sign, to illuminate a store or to supply the motive power to operate a factory or a traction system, the main point, the electrical energy, the "juice" that makes the wheels go around, should never be overshadowed.

To get the most out of newspaper advertising (in the estimation of the writer) requires a specialist to prepare the copy. A bookkeeper can not do it—a stenographer can not do it; would you call in a lawyer to treat your wife for a fever? No! it requires a specialist—one who has given the particular disease thought and attention, who has made a study of the treatment required for the case, and knows just how to diagnose it. So it is in advertising to-day—unsecured business is a disease and if treated properly can be cured, but if let run, is fatal. Advertising right requires thought, individual treatment and undivided attention.

The larger electric companies have their advertising specialist. The smaller central-station manager, whose business will not warrant a specialist to treat his individual case, has—thanks to a few far-seeing and progressive "publicity promoters"—the benefit of the Co-operative Electrical Development Association, which was organized for the purpose of educating the public and furthering the development of electrical energy for every possible use to which it can be applied. To such stations as are unable to cope with the situation locally, the service of the Co-operative Electrical Development Association will be invaluable.

Newspaper advertising used to awaken the public to the possibilities of electric service and to impress it with the fact that your business is governed to the largest possible extent by the same principles applying to any retail business, has a very great effect, and it will also get some business; but it takes a combination of newspaper advertising, mail literature and personal solicitation to take the kinks out of the day or night load. Use the newspapers as a forerunner of enlightenment or to "blaze the trail" for the more "direct-to-you" methods of publicity.

Successful newspaper advertising for central stations must be characteristic; in other words, there should be in every advertisement that amount of significance, or "advertising character," that compels the reader to grasp at a glance the full import of the advertisement. I have seen full-page advertisements that did not have the attractive force, the advertising character, nor the convincing, clinching argument, that a four-inch single-column advertisement would have if properly worded and displayed.

I submit that an advertising campaign should be laid out a whole season in advance, so that at the beginning the advertiser knows what kind of an advertisement he is going to use at the end of the campaign, and has a "mind-picture" of what the results will be without imagining anything; for advertising in a hand-to-mouth way will accomplish nothing except to break up the advertiser. What would be your opinion of a contractor who started out to construct a building without knowing what kind of a building he was going to have when it was completed? The same thing applies to advertising—know what you are going to say six months from now in order not to make a statement to-day that you might be sorry for in the future.

Again, and finally, to get the most out of newspaper advertising it is absolutely necessary to tell the truth. "Confidence ads." deliberately take the people in—at least once; on the other hand, "ads. of confidence" will take them into your salesroom once and many times thereafter. A legitimate business can easily be ruined by misrepresentation. It takes much time to establish a good reputation and little time to ruin it; but, when once established with a foundation of honesty and truthfulness, the public soon learns this fact, and that of itself becomes your best advertisement.

Then—be brief. Have something to say—say it—stop.

A. D. Mackie

MEASURING THE RESULTS OF ADVERTISING

It is my conviction, founded on a long experience, that in any community where the seed has been sown, where an advertising campaign has been conducted along right lines and is being continued under adequate auspices and fairly favorable conditions, the advertising should be responsible for and produce, directly and indirectly, at least 60 per cent of the business.

To accomplish this result, however, there must be modern and progressive management on the part of the central station, and the employment in charge of the publicity department not of an advertisement writer, but of an *advertising man*. These do not grow on every tree and are worth real money when you find them, but they can be secured if you are willing to pay the figures offered by other lines for ability, equipment and experience of this kind. In advertising, more than in almost any other department of business activity, it is a true and trenchant fact that cheap men are dear at any price.

Another indispensable condition is that the advertising and contract departments shall be tied in—knit together by the closest bonds of mutual understanding and helpfulness.

It is impossible to measure all the results of advertising, both because of the nature of much of it, and also because effects may be—nay, often are—so far-reaching that all track or visible trace of first cause is lost. But at least the immediate results of certain highly-important classes of advertising may be definitely traced and accurately measured.

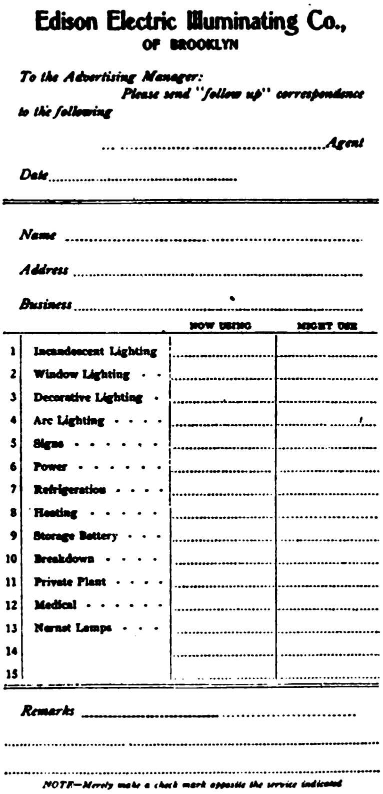
There are two well-defined divisions into which all central-station advertising naturally falls: general educative advertising —the planting of the propaganda—and direct-by-mail advertising —the reaping of results.

To the former class belong street-car advertising, billboards and placards of all kinds, all circulars and printed matter of a purely informing character, and most of the advertising we do in newspapers and other publications. If planned and placed with judgment and ability this kind of advertising is doubtless very effective—reaches thousands we could reach in no other way—familiarizes, suggests, educates; attracts attention, arouses interest, creates desire; clears the ground for our solicitors and lays the foundation on which the structure of much of their future business is reared. Yet the results of this kind of advertising, while they may be appraised, can not be definitely measured. Such advertising should have a general tonic effect on business, and if it has the right strength and pulling power we hear from it in divers ways. People talk about it, write or call about it. The newspapers may publish articles inspired by it. Our solicitors hear from it frequently, and a few contracts may be traced to it. But there is no way by which any reliable record of returns can be compiled or tabulated.

But with the direct-by-mail advertising it is different. We can carry on an advertising campaign addressed to a list of 50 names or 50,000, keep exact record of every piece of matter sent to every name, of each response, whether by means of return post card or otherwise, of whether that response leads to business and, if so, how much and of what nature. In this way we can tell to a fraction the cost of such a campaign and exactly what we gather from it in immediate returns. The potentialities, the future possibilities from such campaigns, are the only items left for conjecture.

The character of help required for this record work is inexpensive, and the keeping of such records, while adding largely to our definite knowledge about advertising and giving us an accurate gauge as to the results of our expenditures in this line, adds comparatively little to the cost of publicity.

The lists to be exploited can be compiled or secured in various ways. As a rule, I have found the most productive lists those supplied by the solicitors themselves. Make it imperative as a part of their work to furnish you each day with the names of a certain number of prospects. In Brooklyn we furnish the solicitors with blanks on which each one is required to send in three names daily, indicating also the character of the advertising to be used, whether power, signs, residence lighting, window lighting, store lighting by incandescents, by arcs, by Nernst lamps, and so forth. A record card is made out for each name and the cards are filed away in cabinets under convenient classifications.



Edison Electric Illuminating Co.,
OF BROOKLYN

To the Advertising Manager:
Please send "follow up" correspondence to the following

Agent

Date

Name

Address

Business

		NOW USING	MIGHT USE
1	Incandescent Lighting		
2	Window Lighting		
3	Decorative Lighting		
4	Arc Lighting		
5	Signs		
6	Power		
7	Refrigeration		
8	Heating		
9	Storage Battery		
10	Breakdown		
11	Private Plant		
12	Medical		
13	Nernst Lamps		
14			
15			

Remarks

NOTE—Merely make a check mark opposite the service indicated

A series of "follow-up" advertisements has been prepared for each one of the principal phases of the business. These are composed partly of letters, partly of booklets, folders and cards. The letters are printed from ribbons in perfect imitation of type-writer, the names and addresses at top filled in to an accurate match and the signatures written. The arguments used are as forceful and convincing as we can make them and generally appeal to the money-making desire of the storekeeper and the home-loving instinct of the householder. One piece in the series is sent each week to each one on the list, and every piece of mail

Ten little tradesmen, and no electric sign.

One left his place in gloom, then there were nine.

The Grocer.

Nine little tradesmen, keeping open late.

One thought that gas would do—then there were eight.

The Baker.

Two little tradesmen, when darkness had arrived

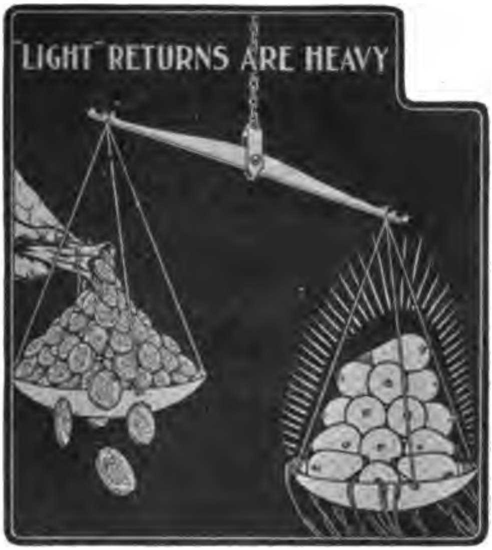
Still always kept it dark—and only one survived.

The Restaurant Man.

One little tradesman, warned by fate of other nine.

Installed Electric Light—and now he's doing fine.

matter includes or encloses a return post card. Each post card is "keyed" with a small rubber-stamp mark, so that when returned the particular advertisement to which it is a response can be ascertained at a glance. As each piece is sent out, the symbol which designates it and the date are stamped on the particular record card made out in the name of the party to whom it is mailed. As each returned post card is received the fact is inscribed on the proper record card. A blank label is then pasted on one side of the post card and it is forwarded to the district



The Example of Success is a good one to follow. Do you know any retail merchant who has achieved a marked success in business within the past ten years whose store is not brilliantly illuminated with electric light?

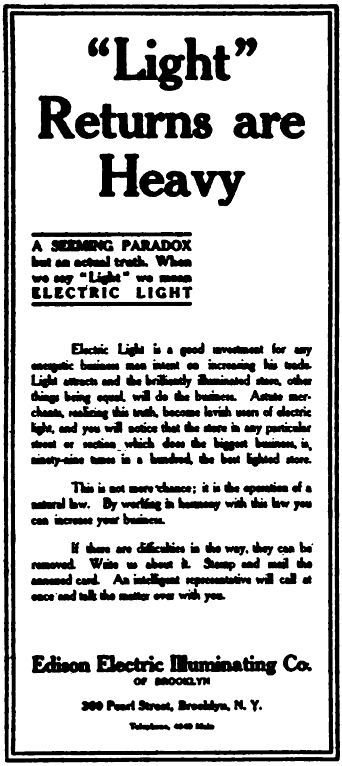
¶ Light attracts. Darkness, dimness, a half light or a harsh light, repels. If you would succeed you must be willing to invest in electric light. This is a condition indispensable to success.

¶ Electric light in Brooklyn is now cheap. Every business man can afford it. No business man can afford to be without it. If your store is not wired, that can be arranged. Write us about it.

Edison Electric Illuminating Co. of Brooklyn

360 PEARL STREET TELEPHONE, [illegible] MAIN BROOKLYN, N. Y.

agent from whose territory it comes, attached to a copy of the advertisement which produced the reply. The district agent reports the result of his efforts on the label, and the card is returned to the follow-up bureau for record. A report is made weekly to the advertising manager as to the pieces of advertising of the different types issued, the post-card returns, and the contracts signed, both as to number and what they mean in 16-cp equivalents. He in turn reports to the general manager.



"Light"
Returns are
Heavy

A SEEMING PARADOX
but an actual truth. When
we say "Light" we mean
ELECTRIC LIGHT

Electric Light is a good investment for any energetic business man intent on increasing his trade. Light attracts and the brilliantly illuminated store, other things being equal, will do the business. Astute merchants, realizing this truth, become lavish users of electric light, and you will notice that the store in any particular street or section which does the biggest business, is, ninety-nine times in a hundred, the best lighted store.

This is not mere chance; it is the operation of a natural law. By working in harmony with this law you can increase your business.

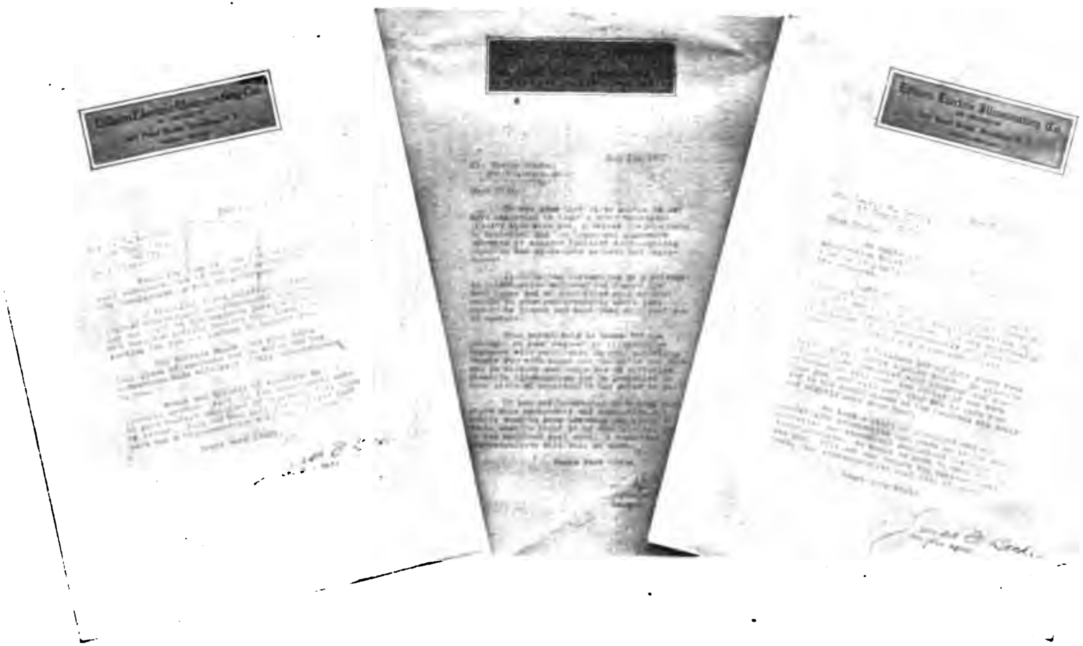
If there are difficulties in the way, they can be removed. Write us about it. Stamp and mail the annexed card. An intelligent representative will call at once and talk the matter over with you.

Edison Electric Illuminating Co.
OF BROOKLYN

[illegible] Pearl Street, Brooklyn, N. Y.

Telephone, [illegible] Main

In connection with this advertising system, the contract department makes out a "prospect card" for each name sent in to the follow-up bureau by the district agent, on which card is registered the record of his calls. In this way a tab is kept on the solicitor, and frequent calls upon the prospect during the period he is being circularized are prescribed and insisted upon.



Edison Electric Illuminating Co.

CP—9

This is a bare outline of the system. In Brooklyn it is a continuous performance. In three or four days, two or three hundred follow-up names accumulate. Record cards are made out and the first letter of a series mailed. Three or four days later another set of names has been received and the same process ensues. Thus, each day sees the advertising issue to active lists and witnesses its own crop of post cards and contracts. This

PLACE
ONE-CENT
STAMP
HERE

Post Card

Edison Electric Illuminating Co.
OF BROOKLYN
360 PEARL STREET
BROOKLYN, N. Y.

HAVE YOU TRIED THIS KEY?

"Don't get discouraged. It is often the last key on the bunch that opens the lock."

¶ If your business hasn't panned out quite as well as it should—if it hasn't made as much money as it ought—try electric light, which is an effective, modern panacea for the sluggish retail business. Light attracts attention and customers. People *will* buy in a brightly illuminated store. No big business has of late years been done in a dimly lighted place. Maybe electric light is the "key" you have been looking for to open the lock of success. Properly installed electric light is practically as cheap as gas. If your store is not wired we will be glad to submit plans and estimates. Tear off, stamp and return the annexed post card.

EDISON ELECTRIC ILLUMINATING CO. OF BROOKLYN
360 PEARL STREET BROOKLYN, N. Y. Telephone, 4040 Main

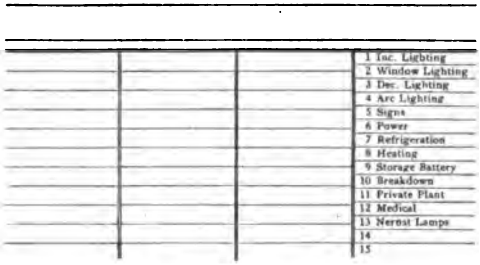
Edison Electric Illuminating Co. of Brooklyn
360 Pearl Street, Brooklyn

CONTRACT AND ADVERTISING DEPARTMENTS

Report of "Follow Up," Week Ending..............................

	Requests Received	Ads Issued	Replies Received	Contracts Closed	
				No.	16 C. P. Equiv.
Residences					
Stores					
Signs					
Power					
Total					

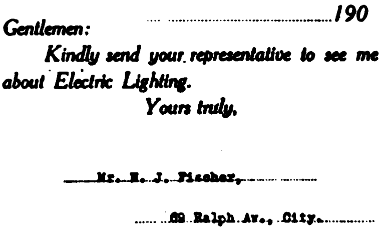
does not interfere with nor interrupt the issue of circulars, booklets and other mail matter not connected with the follow-up



1 Inc. Lighting
2 Window Lighting
3 Dec. Lighting
4 Arc Lighting
5 Signs
6 Power
7 Refrigeration
8 Heating
9 Storage Battery
10 Breakdown
11 Private Plant
12 Medical
13 Nernst Lamps
14
15

series, and many thousands of such pieces are sent every month to selected lists.

The number of different pieces of advertising in a follow-up



Gentlemen: *190*

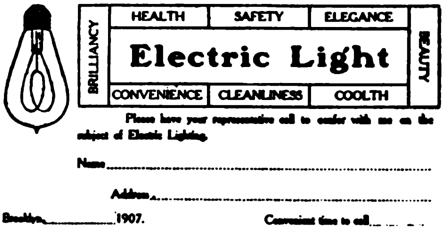
Kindly send your representative to see me about Electric Lighting.

Yours truly,

Mr. H. J. Fischer,

69 Ralph Av., City.

series varies. There are ten pieces in our residence series, seven in the incandescent store-lighting series, five in the sign series,



HEALTH | SAFETY | ELEGANCE

BRILLIANCY

Electric Light

BEAUTY

CONVENIENCE | CLEANLINESS | COOLTH

Please have your representative call to confer with me on the subject of Electric Lighting.

Name..

Address..

Brooklyn..................1907. Convenient time to call............

and so forth. In each case a piece a week is sent to each prospect.

The volume of results necessarily depends on two items:

vitality of the lists and effectiveness of the advertising. In Brooklyn the workings of this system have proven highly satisfactory. For example, let me cite results from follow-up advertising in the latest month for which figures are obtainable at this writing—April, 1907. During this month the bureau completed the work of sending follow-up literature to ten lists, comprising 1660 names. This does not include the many lists partially circularized in April to be finished in May or June, but only those actually closed up in April, the current results from which can, therefore, be finally computed. To these 1660 addresses were sent 9262 pieces of advertising. The cost for printing, envelopes and postage was $195. One hundred and three of the 1660, or 6.2 per cent, signed contracts during April alone. Of these 29 were the direct result of post-card returns, while 74 were signed as the result of special solicitation (coincident with or immediately following and co-operating with the advertising) directed and supervised from the office.

Thirty-two of these contracts were for signs at a flat rate of $91 a year, yielding an annual revenue of $2,912. One was for a sign that pays $144 a year. The other 70 contracts, mostly for store lighting, aggregated business amounting to 2415 16-cp equivalents. The annual revenue per 16-cp equivalent of connected load in Brooklyn averages about $3. At this figure the revenue from these 70 contracts would amount to $7,245 a year. The total annual revenue from the new business gained in this one month in connection with this portion of the company's advertising is thus seen to be $10,301.

This result was not gained from virgin soil, but in a territory wherein careful solicitation had been carried on for years, and which had been previously exploited by a number of well-directed advertising campaigns.

M. S. Seelman, Jr.

THE VALUE OF THE SERVICE OF THE ADVERTISING AGENCY OR SPECIALIST

In discussing the value of the service of the advertising agency or specialist to the central station I am assuming for the most part that all concede the value of advertising as a means of securing new business, but I think that this paper would not be complete without touching upon this value.

It is without doubt acknowledged that in the past few years the subject of advertising has received the most widespread attention from every individual, company and corporation that is alive to the possibilities of getting more business and making new business by widespread publicity over the field they serve and by the education of the public therein to better things where this is necessary, as it almost invariably is. This publicity can best be effected through the means of the various forms of advertising.

Advertising is a vocation in itself, and the busy manager of any business—and the central-station manager more than any other, I think—has not the time nor adaptation, very often, to plan and carry out the details of an effective advertising campaign. It is here that the advertising agency or specialist comes to the rescue of the central-station manager.

With its organized corps of specialists the advertising agency or specialist takes the situation of the central stations—which is very similar in general the country over—in hand and adapts an advertising campaign to the individual station needs with mere suggestions from the central-station official as to the special local conditions to be considered.

From this it will be seen that the specially-organized advertising agency or specialist's force can produce an enormous amount of advertising matter suitable for central stations, with only few changes or additions for local conditions, at a price far below that at which it would be possible for the individual central station to produce it, and to which the central station would have to add the expense of a comparatively high-priced man or men to obtain anything like the quality of matter and service given by the agency or specialist, or else of necessity curtail the effectiveness of one or more comparatively high-salaried members of the management in their regular duties.

The services of the advertising agency or specialist in relieving the management of practically all of the details of editing and composition will be found to be a great boon to the busy central-station manager, who is more often than not overburdened with too multitudinous duties. In the case of direct-by-mail advertising, which is sent out from the agency direct to those on the mailing list, all directed and stamped, the central station relieved of the periodical rush of getting the advertising matter off to the delay of other, regular, work, doing away with the necessity of having extra clerks at the mailing periods; in short, the advertising agency or specialist is to the central station as the central station is to the consumer. For, to use one of our own arguments, the advertising agency or specialist turns out advertising in wholesale quantities, while the central station uses it in, at least comparatively, retail quantities, and this we shall have to admit or "eat crow."

One of the strongest arguments to which the advertising agency or specialist can point as to the effectiveness of advertising, is the wonderful increase in the number of central stations that carried on comprehensive advertising campaigns during 1906 as compared with 1905, which I attribute as the direct result of their efforts through the medium of advertising matter sent out by them to the central stations, which was brought about and made possible by the work of the Co-operative Electrical Development Association, which has been so ably fathered by Mr. J. Robert Crouse, to whom, I think we shall agree, no end of credit is due.

Following are a few figures showing the increase in advertising carried on during 1906 by the central stations just referred to, which are taken from data obtained and compiled by the Co-operative Electrical Development Association as taken from reports obtained from 943 plants throughout the United States. There is an increase of 65 per cent in the number of new-business departments organized in 1906 over 1905. One hundred and sixty-five plants added solicitors in 1906, totaling 331, solicitors to follow and back up their advertising and to obtain the greatest benefits from it. During the year over 11 times as many plants began direct advertising as did previously, and 8 times as many began newspaper advertising as did previously, and during 1906 the advertising appropriations were increased by 195 of the plants reporting. For the 43 plants reporting an increase in appropriation in dollars the total is $42,250.00; and 33 plants reported increase of appropriation for the year in percentages varying from 25 to 615 per cent for the different states in which the plants are located.

During the year 165 plants opened up display-rooms to further supplement their advertising, which is an increase of more than 330 per cent over the number of display-rooms opened up previously.

All of this goes to show what can be accomplished by good, systematic advertising, followed up by solicitors, and so it has been with the central stations that have been carrying on comprehensive advertising.

Time has not permitted getting detailed reports from the many central stations that have carried on comprehensive and systematic advertising during the past year; but the following case in point shows what has been accomplished, and though this case may be rather exceptional it will serve to show what can be done by good advertising.

To 1000 residences in a city in the Middle West, having a population of about 150,000, there was sent a systematic course of advertising matter from June to December, at which latter time two solicitors were put out on this list of 1000 residences for the purpose of determining what results the advertising had accomplished by way of having the householders wire their houses. In April the solicitors reported that 243 houses were found wired, and that during the period of their work, from December to April, 653 of the occupants made request for wiremen to call and give them figures. The occupants of 82 houses of the 243 found wired voluntarily stated that the wiring of their houses resulted from the advertising literature.

If every central-station manager could be assured of obtaining results that would show a percentage one-half as great as that in the case just cited it would, I think, be safe to say there would not be a central station but would take advantage of one of the several means of publicity to bring to the immediate attention of the public served by his station the many uses to which electricity can be advantageously put, and to give opportunity to the public to appreciate the merits of electric service.

How can we expect the public to appreciate the merits of electric service and know the many uses to which electricity can be put if we do not bring to its attention these merits and uses? Do we expect that some kind fairy godmother will whisper in the ear of the public for us that electric service for lighting, power and so forth, is the best, cheapest, cleanest, brighest, most convenient, and altogether the most desirable of all the means for these purposes? Shall we expect to depend entirely upon the expensive mode of publicity derived from the solicitor, unaided by advertising as a forerunner? Or shall we, after looking over the field we serve, select that mode of advertising best suited to the conditions, and see that the prospects in the field are reached by it systematically to open up the way for the solicitor, and thus have the prospects ready, and many times with minds more than half made up in favor of the service?

None of us can estimate the many indirect advantages the central station derives from comprehensive advertising in the way of prestige accruing from the fact that the public places its estimate of progressiveness upon the business that uses progressive methods. It certainly makes the public feel that he who advertises believes in his wares.

In short, the central station that does not advertise fails to make use of one of the most productive means of securing more business and creating new business at the lowest cost, and I might say that one of the most important functions of good, sound, sensible advertising is the opening up of the way for the creation of new business.

Some will doubtless say that all of this can be done by soliciting. Not so; for if the solicitor canvasses the whole field presented to the central stations I dare to say that, unaided by some good form of advertising as a forerunner, on the first call a hearing will not be accorded him by a majority of those called upon, and particularly will this be true in the residence districts. But with good, sound advertising preceding the solicitor and paving the way for him, and making unobtrusive calls between his personal calls, he will find the otherwise implacable majority ready to at least give him a hearing, which is, of course, half the battle.

I do not presume to say that all of our efforts should begin, live and end in advertising, by any manner of means; but it is a most formidable adjunct to the sinews of war for the conquest of new business, when properly prepared, used and followed up for the local conditions to be met.

Granting that the central station of to-day can not afford to omit good, sound, systematic advertising from its fighting equipment for creating and getting new business, it will, I think, also be as readily conceded after due consideration that the advertising agency or specialist is invaluable to the central station for furnishing the advertising copy, cuts and matter, for the several reasons above recited.

Lawrence Manning

DISPLAY-ROOM AND DEMONSTRATION AS BUSINESS-GETTERS

The value of a display-room and demonstration as business-getters for central stations is now being realized by many, and speaking from the experience of the company with which I am connected I can say that I consider they are most important factors in connection with a new-business department. The majority of gas companies maintain a display-room even in places where they employ no solicitors for new business and do no other advertising. This tends to prove that it is a wise policy to adopt; and must be considered by them a large factor for getting business, especially those companies using it without other aid. Up to the present time, very few central stations have opened a display-room, due, no doubt, to the fact that its importance as a business-getter has never been fully brought to their attention. The few central stations maintaining display-rooms consider them valuable means of advertising, also of considerable educational value. The Boston Edison Company is the pioneer in this line; having maintained a very extensive and elaborate display-room for several years, evidently realizing long ago its efficacy as a business-getter. The results obtained by the display-room of the Boston Edison Company have been so satisfactory that in moving into the new building, recently completed, more room has been given and efforts have been doubled to make it as interesting and attractive as possible. Figure 1 shows a view recently taken of this display-room. Many central stations throughout the country have a few motors fixtures and miscellaneous appliances on display, but no effort has apparently been made to show them, and in some cases the display is allowed to remain month after month. A display of this character is of little value.

To obtain the best results, the display-room should be located in a store on a prominent street, with large show windows brightly and attractively lighted, and kept open evenings. Manufacturers are generally willing to co-operate, and apparatus can be secured from many of them on consignment, as it gives them an opportunity to show their goods under most favorable conditions. Local concerns, however, should be given preference, as it tends to create a feeling of good will and co-operation on their part, which should be encouraged. Needless to say, everything electrical should be installed, connected and ready for demonstration at any and all times. It is desirable to have in operation as many working exhibits as possible, such as pumps, coffee mill, meat chopper, Gray telautograph, forge blower; also sign flashers, self-flashing lamps, and so forth. Everything should be up to date. Apparatus out of order should either be repaired promptly or removed and nothing obsolete allowed to remain.

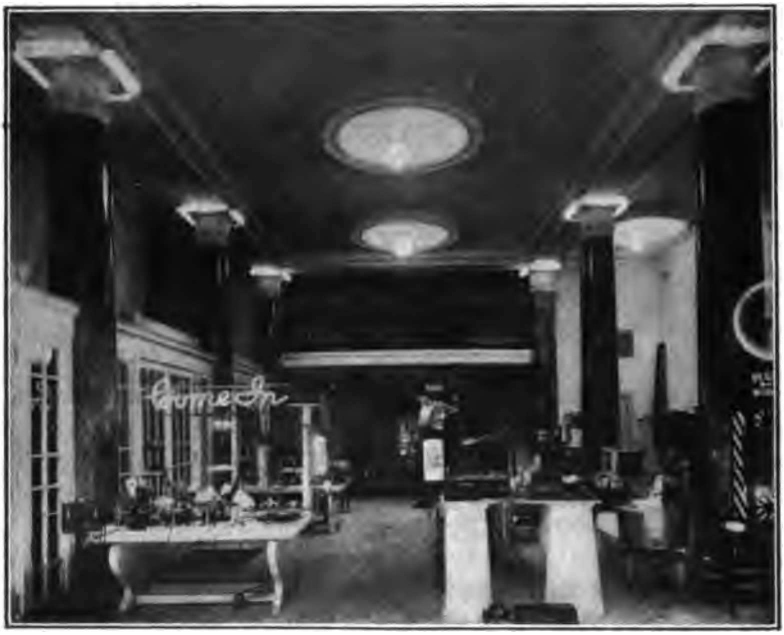


FIG. 1—INTERIOR VIEW OF BOSTON EDISON COMPANY'S DISPLAY-ROOM

A capable man should be selected to take charge—one who is thoroughly familiar with the details of every device exhibited—and with assistants equally well posted. Young women as demonstrators on domestic appliances are usually the most satisfactory.

They should be of good appearance, able to talk interestingly and convincingly, and be enthusiastic over the merits of the devices shown. It is also essential that all of the attendants have at least some of these qualifications. Without them you are failing to catch and hold the interest of the casual visitor by not having your goods presented in the proper manner. It is a good practice for the young women to wear maids' caps and aprons, or other suitable costumes. This gives a touch of distinction and is especially desirable where other demonstrations of food are being given, for instance, in a food fair.

The announcement of the opening of a display-room, and later the appliances being demonstrated at different intervals, can be done through the columns of the local newspapers, in addition to printed invitations distributed to customers of the company. Small pasters or stickers can be attached to your customers' monthly bills, calling their attention to an appliance being demonstrated in your display-room at that time. Of course there is no limit to the circular matter that can be distributed in this connection, but from the experience of our company we found but little printers' ink necessary, which was probably due to the prominent location of our display-room.

FIG. 2—INVITATION DISTRIBUTED TO CUSTOMERS BY THE COMPANY

The show window is of the utmost importance and should be carefully and thoughtfully planned to make it as attractive as possible. That the window attracts and holds the attention of the passer-by is shown in Figure 3. Upon it largely depends the number of people visiting your display-room. It is well to arrange for demonstrations in your window of as many appliances as possible, taking one at a time for a few weeks each. For instance, have a young woman, wearing a suitable costume, bake biscuits in an electric oven and distribute them in pasteboard boxes to visitors as souvenirs. Take the electric flat-iron next; after that the sewing-machine motor, and so forth. Don't confine your demonstrations only to good revenue producers, but take the Gray telautograph, the commercial graphophone, and other devices, giving you the variety necessary to stimulate and hold the interest of the public. It is also a good plan to have in your window some attraction after the premises are closed. A large Holophane hemisphere (about 20 inches in diameter), with self-flashing colored lamps arranged to burn all night, gives a very pretty effect and will attract the attention of the passer-by to the window. This can be replaced with the winking owl, and

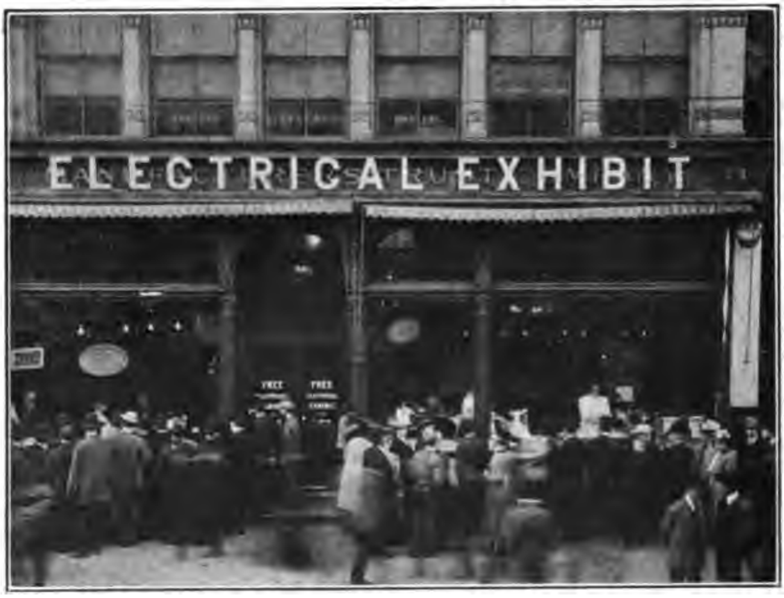


FIG. 3—THE CROWDS WATCHING DEMONSTRATION IN WINDOWS

other novelties from time to time. Different methods of window lighting can be advantageously shown in your windows, and the wiring arranged so that one method of a kind can be shown at a time to an interested merchant.

FIG. 4—ELECTRICALLY-BAKED BISCUITS

The interior lighting can be arranged for display, also to show the different methods of illumination, together with various styles of fixtures for use in the home, store, office, and so forth,

FIG. 5—DEMONSTRATOR BAKING BISCUITS

and special types of lamps, such as mercury vapor, and others. Now that proper illumination is being considered more than heretofore, it is well to have a small room or booth that can be darkened for the purpose of showing the effect of different styles and types of shades; also effect of different wall colorings. The latter may be accomplished by means of a variety of shades or curtains on rollers placed on side walls near the ceiling, by use of which different color schemes may be obtained.

The interior furnishings should be arranged as attractively and artistically as possible. A dark nook or corner, if any, may be transformed into a small booth darkened with hangings for displaying portable fixtures to advantage, as shown in Figure 6. By co-operating with the local fixture concerns you can, no doubt, make arrangements whereby each of them will have an opportunity of displaying their fixtures in this booth at different intervals. The grouping of other appliances, such as dental and medical apparatus, can be effectively arranged on tables.

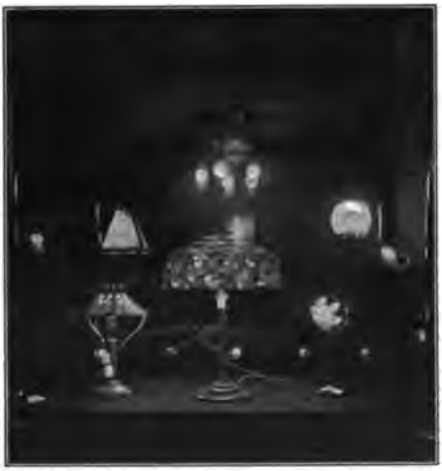


FIG. 6—HOW A DARK CORNER CAN BE USED FOR DECORATIVE LAMP DISPLAY

The domestic heating and cooking appliances may best be shown in small rooms or divisions arranged as nearly as possible to represent a kitchen or a dining-room. Figure 7 shows one of our windows fitted up temporarily as a kitchen, while Figure 8 represents a dining-room—the latter being a permanent arrangement.

To those companies that may at some later date inaugurate a display-room, let me suggest that it is important that consider-

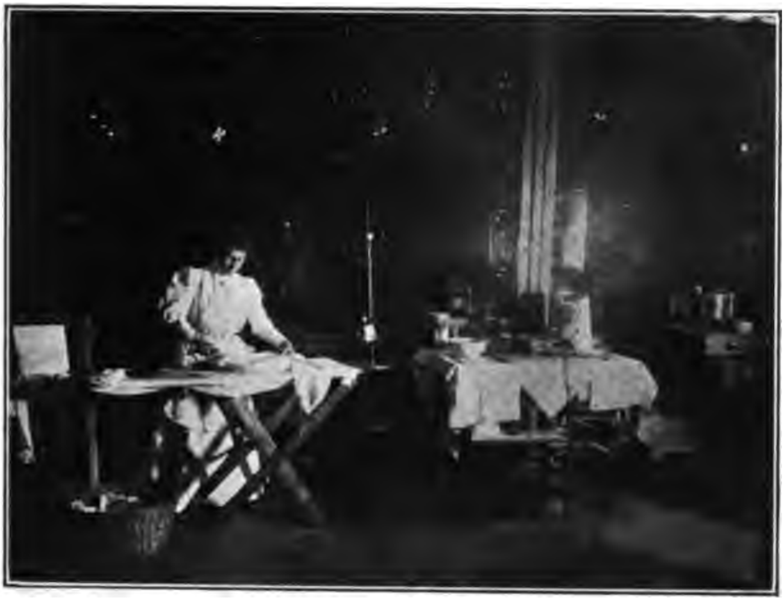


FIG. 7—WINDOW FITTED UP TEMPORARILY AS A KITCHEN

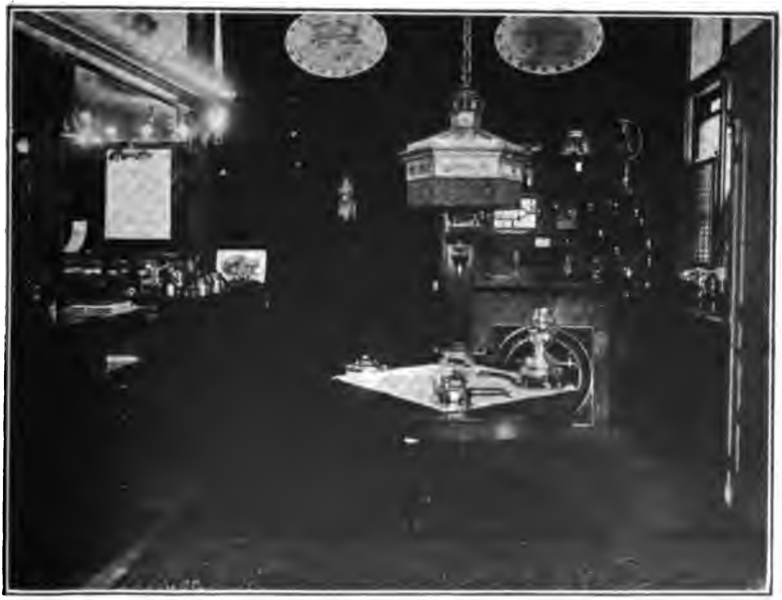


FIG. 8—ONE OF THE EXHIBITION SPACES ARRANGED AS A DINING-ROOM

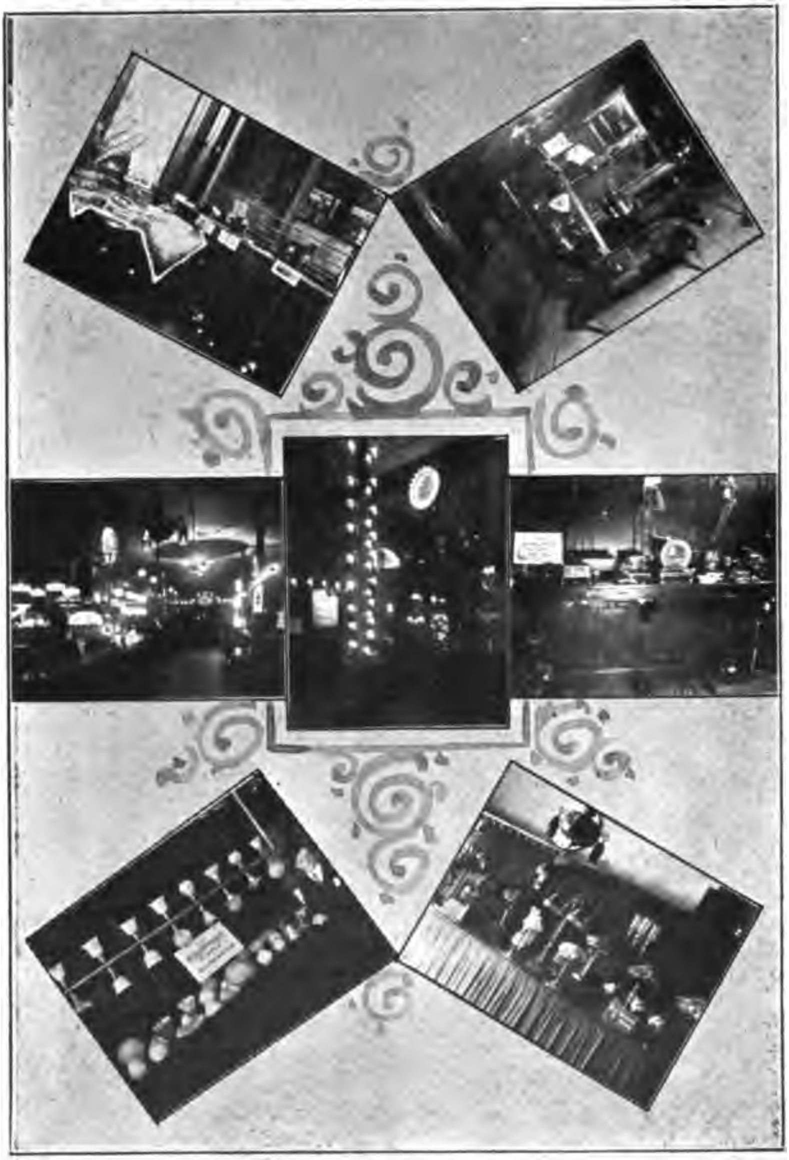


FIG. 9—TEMPORARY DISPLAY-ROOM, NARRAGANSETT ELECTRIC LIGHTING COMPANY, PROVIDENCE, R. I.

able attention be given it in order to secure the best results. If it is run as a side issue, you not only show it in appearance, but fail to accomplish proper results. Too much can not be expected of direct results. The results at the start will probably be small, but should increase from time to time as the public becomes familiar with it.

E. R. Davenport

NEW BUSINESS BY INDIRECT METHODS

Central-station managers who have given the question thought will, I believe, admit that it is more difficult to approach and enlist the attention and interest of residential prospects than those of a commercial character. The business man or his representative can be found during business hours, and is susceptible to arguments that would not carry with the householder. To illustrate: We often find that after equipping, we will say, Jones' shoe store with a first-class electric-lighting effect, his competitor, Mr. Brown, will be inclined to have something just as good as Jones when his attention is called to the superiority of the other fellow's illumination. It would be the height of presumption, however, to say to the lady of the house that her next-door neighbor burned electric light and if she wanted to be up to date and hold her own it would be well to follow suit. The writer has observed many cases where an entire neighborhood has followed the example of the first person installing electricity. From experience it has been a waiting game, however, and not one susceptible of acceleration by a line of argument that could be followed and would be readily welcomed in the case of the storekeeper.

The Union Electric Company, of Dubuque, has for the past two years made a special effort to secure additional connected load from the residential districts. Bulletins, circular letters, special matter furnished by the trade, newspaper space and personal solicitation have been used to bring about the desired results. That the seed thus sown has been well sown is evidenced by the securing of a large amount of business that we have been pegging away at for several years.

While "In the spring a young man's fancy lightly turns to thoughts of love," the central-station managers' thoughts turn to house-cleaning, carpet-beating, and the general spring renovation undertaken by the progressive housewife—what better season for the vigorous prosecution of the residential campaign?

The company concluded that with all the word-paintings, illustrated matter, and so forth, that had gone from its office to the prospects it was about time to give the public at large an ocular demonstration. The first plan was to put on a simple cooking demonstration with a daily lecture, introducing at the same time the sewing-machine motor, electric iron, chafing dish, heating pad, and other of the well-known and thoroughly reliable devices. It came to the attention of the company that the Household Economics Division of the Dubuque Woman's Club was ambitious to enlighten the public along the lines of domestic science. This club has a membership of 400 of the city's representative women. The company realized that the hearty co-operation and support of the club would lend a tone and dignity to the proposed demonstration that it would be impossible to otherwise attain. Knowing that the club would not consider lending its name to any movement that was plainly based on commercialism, the company made a proposition, which, stated briefly, was as follows:

We, the company, will take care of every item of expense involved in a 15-day series of lectures and demonstrations, provide the demonstrators, tools, appliances and foodstuffs required, and undertake all expense of entertainment of the lecturers who may respond to an invitation of the division. The movement will be announced as under the sole direction of the division; company's name will not be featured, or, in fact, appear in any manner unless it be on some of the advertising matter that will be given to parties interested in the appliances shown. The company's object is entirely educational—no price tags will be attached to any electrical device and no prices quoted unless requested, the idea being that the company's benefits will be indirect, following in the wake of such interest as may be created through the lectures and exhibits.

This arrangement having been effected, the company secured a storeroom on the main street in the heart of the commercial district. The room was 40 feet front, 125 feet deep, with a 16-foot ceiling and two handsome plate-glass show windows.

The first and most important feature was the construction of a model six-room cottage, the ground plan of which will be shown to those interested, but it is better illustrated by the photographs accompanying this article. This cottage was a complete structure in every detail except the extension of the shingle roof beyond the centre of the peak, as shown in photograph taken from the front. The rooms were finished with tongue-and-groove material of first quality, and the color scheme carried throughout as if for actual occupancy. The furnishings were complete in every detail, electricity naturally being featured. On the porch was shown a 16-cp lamp enclosed in a ground-glass globe with a metal vine-and-leaf design encircling the same. At the front door was regulation push-button for bell, the hall was well lighted with ground-glass ball, same containing a 32-cp lamp. The idea being to show effects which were not extravagant, thereby catering to the popular demand, simplicity and efficiency were more of a consideration than any other. The parlor had a simple three-light fixture, luminous radiator, and on a pedestal in one corner was a banquet lamp of neat design. The bed-chamber was equipped with two two-light brackets, a turndown night-lamp on a small table, which also carried an electric milk-bottle warmer and a heating pad. An electric curling iron found a place on the dresser, and attached to the head of the brass bedstead was a special reading lamp with chain pull socket.

The dining-room color scheme was red, white and black. On the ceiling were four frosted lamps in the form of a square around a handsome art glass centre-piece suspended by a chain over the dining table. The ceiling lamps were fitted with red paper shades, a Japanese conceit, which harmonized with the rug and centre-piece. In the dining-room was a fully-equipped breakfast set; it contained a coffee percolator, a toaster, a large chafing dish, and a small stove for use in connection with one of the several extra utensils. During the demonstrations this set was very effectively shown in service, the idea being to illustrate the readiness and ease with which a substantial breakfast could be prepared and served in the dining-room.

The library, or den, carried two complete lighting schemes. In moments of lassitude a delightfully restful sensation would be induced through the subdued effect of the red art glass lamp on the centre table, on which was also placed the smoking set. When general illumination was required, it was well provided for through four 16-cp lamps on the ceiling, these being enclosed in ground-glass balls.

The pantry had one lamp in the centre, equipped with a two-ball adjuster which would permit the housekeeper to carry the light to any point desired in the room. In the kitchen was shown an electric cabinet with all appliances.

In the several rooms described mention is made of the electrical features only. The furnishings were carefully worked out, and no detail was overlooked, even to the plate rail with its plates in the dining-room, curtains at the windows, door-mat on the front porch, telephone in the rear hall, push-buttons in all rooms, dish-towel wringer in the kitchen, and all of the many little details that go to make a thoroughly complete domestic establishment. The furnishings were provided by the dealers of the city, who contested most spiritedly for the privilege of contributing their choicest stock for the demonstration.

There were no demonstrations in the cottage proper, but it was at all times illuminated, with an attendant who manipulated the flush switches to show the visitors the various effects obtainable. The 15,000 people who passed through the cottage went in over the front porch, through the main hall into a rear hall affording a second view of the dining-room, by pantry through the kitchen into a passage leading to the main demonstration hall. By the photographs it will be noted that a bit of turf was provided on both sides of the cottage entrance, with blooming flowers in boxes at the windows.

Formal opening of the series was a reception to the Dubuque Woman's Club by the Household Economics Division. Admission was by card of invitation. An orchestra was provided, and more than 400 of the recipients of invitations responded. At the conclusion of the reception refreshments were served by the city's leading caterer—the coffee, tea and chocolate being prepared with electric devices in view of the guests of the evening. The ices were full-sized models of 16-cp lamps in various colors.

On the following day the demonstration was opened to the general public, the programme being as follows: Doors open at

1 p. m., with three operators demonstrating motor-driven washing machine and wringer, electric clothes-drying cabinet, electric irons and motor-driven mangle. These operators worked continuously from one until six o'clock. Two operators were engaged with motor-driven sewing machines—one on practical everyday lines, such as shirts, underwear, dresses, and so forth, the second on finer work, such as shirtwaists, lace collars, handkerchiefs and lingerie.

On the right of the hall Miss Martin, from one until three o'clock, demonstrated coffee percolators, teapots and a battery of chafing dishes which dispensed a continuous stream of delicious fudges and other confections. She also demonstrated the oven on small cakes, cookies and pastries. To afford a more bountiful supply of coffee than the percolators could furnish on account of the large demand, a four-gallon electric coffee machine was installed, with an attendant to draw the fragrant beverage for the visitors. From three until five o'clock Mrs. Sanborn lectured and demonstrated on the left of the hall, her equipment consisting of the largest size cooking outfit, with a complete line of heating units, a motor-driven bread-mixer, a motor-driven dish-washing machine, a large ice-box well stocked, and such other equipment as was required. With a seating capacity in front of the lecturer's platform which accommodated 500 persons, during the 15-day course there was never a vacant chair, many being compelled to stand throughout the two hours consumed by Mrs. Sanborn in her lectures and demonstrations. The lectures were given in plain terms, the idea being to cater to the more popular everyday class of cookery than to go into specialties. The public was admitted from one to six only. In the evening a two-hour session was devoted to a class of about 75 who desired special instruction.

In addition to the devices above described, there was a handsome display of banquet lamps and general lighting effects, as well as domestic utilities, by a local electrical contracting firm. This firm was admitted at the request of the lighting company, with the understanding that it would attempt no sales, though prices could be quoted to inquirers. The only advertising shown in the hall during the series was the sign of the contracting firm and in one section or corner of the hall a group of cards stating that the various furnishings were from the firms whose names were mentioned. The only paid advertising in connection with the announcements of the lectures and demonstrations, consisted of a double-column five-inch space inserted in the three daily papers and carried throughout the course.

Each of the papers devoted from a half to a column and a half of reading matter each day in a recitation of the progress of the work. The company's scrap-book contains over 50 columns of solid reading matter, all of which the newspapers were glad to publish from the fact that it was regarded as live news matter.

During the series there were special evening features consisting of lectures by individuals well known in the field of domestic science. There was also an evening devoted to a discussion of the advisability of introducing domestic science, or the art of home-making and housekeeping, in the public schools, in a regular course. This debate was participated in by the superintendent of the Board of Education and many of the progressive minds of the city.

Admission to all of the evening affairs was by card only, cards being readily obtainable upon request to members of the division or club. Every evening event was attended to the capacity of the hall. The rear end of the hall was completely blocked by the cottage; in the front end lamp-black was applied to the windows over the top of the display sections, thereby shutting out all natural light and giving the artificial brand the entire field without competition.

One feature of the demonstration was an afternoon devoted to the children. Ten demonstrators and attendants prepared and distributed candy and cake to 700 children at the conclusion of a simple little lecture by Mrs. Sanborn.

During the series more than 15,000 people were recorded by the doorkeepers as having attended the lectures and demonstrations. The movement involved the company in considerable expense, and its employees in much work, four or five of the company's people being in constant attendance.

The writer has been asked by a number of central-station managers if the money and time were well spent. While sufficient time has not yet elapsed in which we could expect any great return, we already feel that the movement was entirely successful, and we contemplate making it an annual event. We can not conceive how money could be better spent. People of that class who would not consider attending a pure-food show, who could not be induced to visit our offices and display-rooms, visited these demonstrations many times, and took a keen interest in all they saw and heard.

I would say here that the company did not go into this proposition with the idea of securing large direct returns, but on the broad gauge that the public required enlightenment concerning the flexibility of electricity, and the convenience and comfort which it carries to the home. A large proportion of our audiences had never used electricity and knew absolutely nothing of the many excellent devices which were so ably demonstrated. The feature that excited the keenest interest was the series of evolutions whereby a basket of soiled linen, or to use a more democratic term, the family wash, was on the finished racks ready for use three hours after having been dumped alongside the motor-driven washing machine. Many experienced housewives were inclined to discount the announcement that 40 pieces of miscellaneous linen and wearing apparel could be washed, rinsed, blued, starched, dried and ironed in three hours. With five or six instalments going through this operation daily all doubts were removed. Many critical persons examined the work closely, and invariably pronounced it far superior to the results obtained in their individual establishments. One difficulty encountered was to secure a sufficient stock of material with which to engage the operators. It was found necessary to visit a number of private residences each morning, soliciting the privilege of taking over the responsibilities of the laundress. It might be stated incidentally that this was excellent advertising and resulted in the immediate sale of quite a number of irons. Particular attention was given to the work, and because of the beautiful condition in which the linens were returned it was unnecessary to sing the praises of the electric iron.

Within 15 days following the demonstrations, the contractor who had an exhibit placed on his books 16 house-wiring orders. The contractor and the company have received orders for 6 sewing-machine motors, 18 electric irons and 12 or 15 pieces of miscellaneous heating devices. In addition to this some 30 or 40 residential contracts are being figured, with every indication of the greater percentage being closed. We feel that the results will filter in for a year, and possibly during the next two or three years additions to the connected load will come in as the result of the late demonstration. One direct result has been the engagement of Mrs. Sanborn to return for a three-weeks' engagement at one of the large Catholic educational institutions. This will result in the equipment of a complete electric kitchen, and while the revenue from this individual case may not be large the indirect benefits will be of great value, as undoubtedly other institutions will be inclined to duplicate the move of the first mentioned.

Concerning the cost of the movement, detail of the same is submitted herewith.

COST OF DEMONSTRATION

Printing and advertising	$112.57
Demonstrators, assistants, and expenses of same	366.66
Supplies for demonstrator and caterer	190.60
Watchmen	83.45
Miscellaneous expenses	165.07
Construction and finishing of cottage	360.75
Total	$1,279.10

As an indirect method of enlisting the attention and interest of the desirable classes, this company feels that the plan as briefly outlined in this statement will prove effective even though it may be materially modified.

L. D. Mathes, Dubuque, Iowa

NEW BUSINESS BY INDIRECT METHODS

The purpose of this paper is to describe a means of securing new business by indirect methods used in St. Paul.

Food fairs, electric shows, advertising shows, automobile exhibits, and so forth, are drawing thousands of people in the larger cities every year. When the St. Paul Lodge of Elks planned a pure-food show and home industrial carnival, to be held for a week in the armory, it presented a peculiarly appropriate opportunity to demonstrate to the people of St. Paul the many sanitary and other reasons for the use of electricity for cooking, heating, lighting and ventilating, and to show the possibilities of improved electric appliances. While looking at the different exhibits of pure food, the people could be easily interested in electric methods of preparing these products for the table, and in modern methods of using electricity for light, heat and power.

The armory building was well adapted for the purpose. Upon the space reserved for the company, in the centre of the hall, an octagonal booth was erected, shown in Figure 1, provided for serving and demonstrating on all sides, thus reaching a large number of people at the same time. The large electric sign over the top, and the eight illuminated-letter panel signs around the upper border, served to attract attention to the booth.

Two of the representatives were detailed each afternoon and evening for duty at the show to explain appliances and answer questions. For the direct demonstration of the appliances, the ten young lady demonstrators regularly employed by the company were admirably adapted for showing the operation of appliances to best advantage, as each of these young ladies is a graduate of the university school of domestic science, and can talk intelligently on subjects of domestic economy, as well as show how to make a welsh rarebit in the electric chafing dish, or use an electric flat-iron. These young ladies are regularly employed by the company in making house-to-house demonstrations of gas ranges, broiling or baking on the ranges in the consumers' own kitchens under actual working conditions, and were thus familiar with appliances and with the routine work of the company.

The booth was a busy place throughout the afternoons and evenings of the week the show was held, and the eight broad counters were none too large to permit serving all the people that wanted to examine the exhibit, ask questions, and try the electric coffee, welsh rarebit, or cakes baked in the electric oven. One side of the booth was used for the electric flat-iron exhibit, one of the young ladies showing the convenience and perfect work possible by its use on linens, laces and difficult work. Another counter showed the electric coffee percolator, its product being served with wafers or with cakes baked in the electric oven, which was in operation at one side where it could be easily seen. At another counter welsh rarebit was served from the electric chafing dish, and the convenience of this method of entertaining one's friends was explained. The remainder of the booth was used for the luminous radiator, electric stoves, electric grids and broilers, electric frying pan, cereal cooker, egg boilers, water heaters and milk warmers. The use of small electric motors was also explained by fan motors, sewing-machine motors and buffing and grinding motors. The outline and display lighting of the booth was useful in showing the possibilities of electric advertising to the merchants.

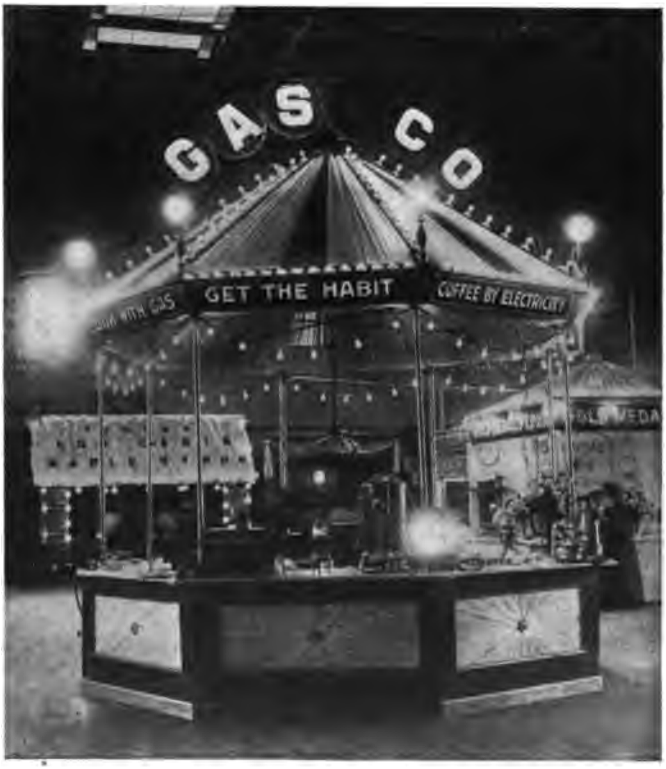
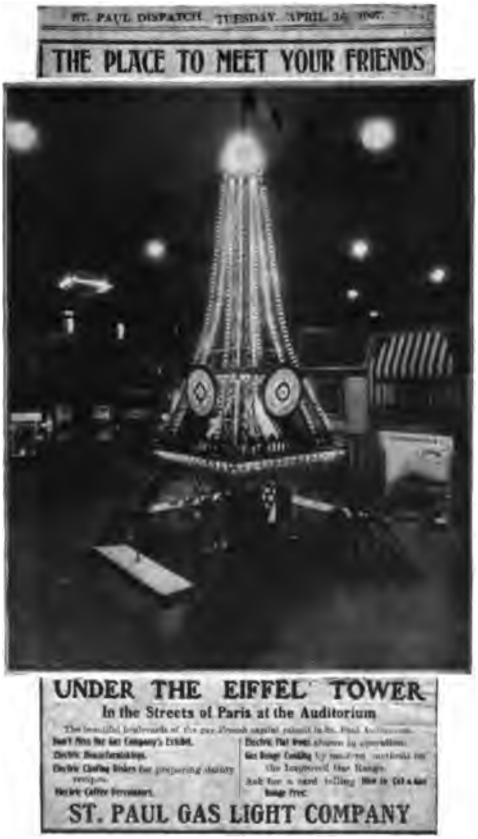


FIG. 1—BOOTH AT PURE FOOD SHOW, ST. PAUL LODGE OF ELKS

The time while people were being served was used in telling them about the appliances, answering questions, and interesting them in electric methods of cooking. They were also given souvenirs and literature to be taken away and read at leisure. These souvenirs included aluminum thimbles, celluloid buttons, yard sticks, and so forth, each carrying some advertising matter descriptive of the product or service of the company. From the fact that the souvenirs were useful in character they were carried



ST. PAUL DISPATCH, TUESDAY, APRIL 16, 1907.

THE PLACE TO MEET YOUR FRIENDS

UNDER THE EIFFEL TOWER

In the Streets of Paris at the Auditorium

ST. PAUL GAS LIGHT COMPANY

FIG. 2—ADVERTISEMENT OF ST. PAUL GAS LIGHT COMPANY, SHOWING BOOTH IN EIFFEL TOWER DESIGN

home and kept, furnishing a standing advertisement of considerable value, in addition to popularizing the exhibit at the time.

The results of this show more than fulfilled expectations; the number of people attending during the week was about 35,000, and from the position in the community of the men behind the enterprise, the publicity gained was most valuable.

The second show of this kind in which the company took part was in April of this year. This show was given by the Junior Pioneers and was called the "Streets of Paris." It was held in the St. Paul Auditorium, which had been completed and turned over to the city only a few weeks before. The perfect appointments and popularity of this new auditorium, built by popular subscription by the people of St. Paul, assured the success of the undertaking, and not less than 50,000 people attended the show during the week. The methods of demonstrating at this show were similar in every respect to the previous one, but the design of the booth, resulting from the nature of the carnival, was even better adapted for display purposes.

The booth reserved for the company was a reproduction of the Eiffel Tower, shown in Figure 2, and was located in the centre of the hall, which was arranged to represent the streets and buildings of the French capital. Newspaper space was used in giving publicity to the exhibit, one of the advertisements used being shown in Figure 2.

The amount of new business these shows were the indirect means of securing and holding is extremely difficult to calculate. The interest in the show and in the company's exhibit, and the number of people it was possible to reach in a convincing way, would hardly have been accomplished by any other means. The favorable comment of press and public, and the spirit of co-operation shown by the company toward two bodies of the best business men, can hardly be estimated in dollars and cents. It is considered that the results more than justified the exhibits. Although these results are difficult of immediate analysis, the effect is far-reaching, and the company will reap its reward for a long time to come.

George Steinwedell

DISCUSSION

Mr. Seelman: With reference to the papers of Mr. Mackie and Mr. Manning, in connection with the advertising done by the agencies, and the value of it to central stations, particularly to the smaller central stations, I believe such advertising can be made of much more value than it is to-day. It is not sufficiently business-like, sufficiently concrete, for the most part. If I were to go before you, as a possible customer for electric lighting, and tell you the advantages of electric current in your home—how no matches are required, it does not throw dirt on the ceiling, does not eat up the oxygen, and so on—you would say, "Yes, I know that," and that would probably be the end of it. But if I should say, "I know you want electric light in your home, and realize the advantages and convenience of it, and the reason you have not got it is because the house is not wired; I will find out and let you know how much it will cost you to wire, and if you are not disposed to pay for it in a lump sum I will spread the payments over one year, in monthly instalments without interest"—I think I should be more likely to get business in that way than if I merely relied on general statements, telling how good electric light is. Make that one of the main points in your advertising rather than merely the general exploitation of the advantages and convenience of the service.

MR. MANNING: I agree with what Mr. Seelman has said. In my paper I made reference to "cheapest, best, cleanest." It should be shown how it is cheapest, best, cleanest. Advertising must be made more concrete. I think advertising should be used as a means of arousing the first interest of the public. The principal object that we have in mind in advertising is to create, first, interest in and attention to our proposition, and when we have done that we have gone a long way toward making our advertising successful. That is what the central-station manager should bear in mind in his advertising campaigns.

The following papers were next read:

Illuminating Engineering as an Aid to Securing and Retaining Business, Mr. C. F. Oehlmann, Cincinnati, Ohio; *Methods of Securing Residential Business,* Mr. R. W. Hemphill, Jr., Ann Arbor, Mich.; *Co-operative Lighting of Streets by Merchants,* Mr. H. J. Gille, St. Paul, Minn.; *Methods of Securing Sign Outlining and Window Lighting,* Mr. Homer Honeywell, Lincoln, Neb.; *Methods of Securing Power Business,* Mr. George N. Tidd, Scranton, Pa.; *Catering to Power for Automobile Charging,* Mr. R. W. Rollins, Hartford, Conn.; *Establishing Day Circuits in Towns of 10,000 Population and Under,* Mr. F. H. Plaice, New Bremen, Ohio; *Commercial Methods of Exploiting Electric Heating Appliances,* Mr. T. K. Jackson, Mobile, Ala.

Light

ILLUMINATING ENGINEERING AS AN AID TO SECURING AND RETAINING BUSINESS

In writing this paper I shall not endeavor to dwell upon the merits of the many makes and styles of incandescent or arc lamps, nor upon the scientific lines of illuminating engineering. These subjects are worthy of careful discussion.

The subject *Illuminating Engineering from a Business-Getting Standpoint* has been and is attracting attention of not only the general management of central stations, but of illuminating engineers, both in the United States and European countries, Germany and England especially. Letters are received daily from illuminating engineers and central stations asking the illuminating engineer to furnish some information regarding the system of work and success obtained.

Mr. Henry L. Doherty was probably the originator of this line of work when a year or two ago he organized a service supervisor department in the new-business department of the Denver Gas and Electric Company under Mr. Clare N. Stannard, new-business manager. The gentlemen acting as service supervisors assumed the duty and responsibility of seeing that present consumers were getting the best possible results or value for the money they were paying for the commodity used. As soon as they saw they had given consumers a higher efficiency on present installation they found it easy to close additional business, and also made a well-pleased consumer.

While these service supervisors were not illuminating engineers, nor did they attempt illuminating engineering beyond the ordinary good common sense that every new-business man should use, they probably installed the idea of the illuminating engineer in connection with the new-business departments. The illuminating engineer is a recent character, probably not more than four years old. The business-getting illuminating engineer is a very recent character, and the work has progressed only far enough to enable one to form but a fair idea of the value of this work.

The daily and monthly reports of the illuminating engineers show a decidedly profitable work, and the annual report will no doubt demonstrate very thoroughly, even to the most sceptical, that the illuminating engineer working in connection with a new-business department is most desirable.

The work of the illuminating engineer is not only to call upon architects, contractors and owners of new buildings, to adjust complaints by the rearrangement of what has been a poor lighting scheme, to educate the electrical wireman to the economy of electric lighting from an illuminant standpoint, but to educate the representatives and salesmen of the new-business department. The latter is the real work of the illuminating engineer and is what makes his work valuable to the central stations. This work may be accomplished in many ways, but the real object is to have the representatives advise with consumers and prospective consumers, making proper suggestions as to the actual necessary installation, neither too much nor too little. Mr. Doherty once reminded the writer that an engineer was a man who could do with one dollar what an ordinary person would use two for.

Representatives making the mistake of advising too much light are in far greater error than in advising too little and are more to be feared, inasmuch as it results in a complaint from the common cause, a high bill, and means either a discontinuance of service or a special rate; and I should like to say at this time that I would prefer to lose the business rather than to make a concession in the rate, thereby admitting my rate to be in error.

The salesmen and representatives of the new-business departments should be familiar with all new reflectors marketed, both concentrating and diffusing, and also the perfect use of same. They should know how to place lamps and sources of light to the best possible advantage from an illuminant standpoint, should know some of the general principles of illuminating engineering, and should also know how to figure cost of operating and maintaining installations of all kinds. These things should all be taught by the illuminating engineer. The illuminating engineer should spend half a day as often as possible with each representative in his respective territory or district, going to different stores, residences halls, churches, and so forth, and advising with the representatives as to the best plan of illumination. These half days, with short lectures each week and daily discussions of new lamps and reflectors, will constitute a splendid means of educating the new-business department men and place the illuminating engineering feature on a par with any work being accomplished by the various central stations.

C. F. Oehlmann

METHODS OF SECURING RESIDENTIAL BUSINESS

I have been asked to say a few words on the methods used and the policies adopted to promote the electric business in the residential districts of cities having a population of from 5,000 to 20,000 inhabitants.

CANVASSING

The first step is to gather the data necessary to lay out a campaign. Select from among your employees two or more good-looking, bright-witted chaps, dress them up in their best clothes and send them out to make a house-to-house canvass.

They should be provided with suitable notebooks, having the name of the street at the head of the page and the street numbers listed down the page. Opposite each number should be columns in which may be noted the desired information. The data we find most valuable are the following:

Number of rooms
Occupant
Owner
What kind of service used
If customer, have they an iron
Wired or piped
Kind of fixtures
Remarks as regards prospect

This field-book is brought to the office and from it a card index system is started. Each card represents a residence, and the information gathered by the canvasser is typewritten on the cards and they are filed in the cabinet. A second canvass is made when the prospects are called on, and all numbers not secured the first trip are filled out.

The line of talk these canvassers are trained to give during this preliminary canvass is as follows: They call for the lady of the house. "Madam, I am the representative of the electric company. Do you have our service?" "No, we use gas." "Can I not interest you? A number of your neighbors are using our service. Our rates have been materially reduced, and the management thought that this spring you would be interested in having us explain its advantages."

If he finds the house is connected on our circuits the talk runs something like this. "I am a representative of the electric company and called to see if our service is entirely satisfactory, and if there is anything we can do for you. The management wants your co-operation in giving good service, and if you can suggest anything along that line we shall be glad to hear of it."

It is certainly astonishing what a pleasant feeling is at once established between the company and the consumer, indirectly paying more than the entire cost of the canvass.

We are now ready to begin work. A certain street is selected and the cards are examined. You decide to send your man after all dwellings not wired. A list is readily made and the replies brought in are added to each card. Different lists are made up in different districts of houses wired but not connected; wired but no fixtures; kerosene-lamp houses (a greater proportion in each town than most people realize); a list of houses using gas, and a great list of houses using combinations of all systems.

Now, this is the regular grind of the soliciting department in the residential districts. We have also a scouting or special department consisting of one man who looks out for new houses, extensive repairs being made on houses, and inquirers from our direct-by-mail advertising. He gets his ammunition from building permits, contractors and newspaper clippings. The rest of each day he puts in, during this time of the year, on irons, and a little later on fan motors; in the fall, on porch lights, and so forth. Small cards are printed for him on the addressograph and these are arranged according to street numbers. He sorts out those that are supplied and goes out after the others. This man is furnished with an engraved card with his name and in the corner the name of the company he represents.

ADVERTISING

We carry on various advertising campaigns, trying to supplement the work of our canvassers.

First—Newspaper Advertising. We carry a double-column, five-inch space with each daily paper, changing the advertisement every week.

Second—Direct-by-Mail Advertising. We mail to 50 per cent of our residences monthly bulletins. We get good results not only by pleasing our present customers but also in getting others to discussing various appliances.

Third—Exhibition-Room. We have in connection with our office a large display window and exhibition-room, kept attractive by frequent changes. We endeavor each month to adopt a special feature, as for instance:

January, small-cp and Hylo lamps
February, motors
March, fixtures
April, irons
May, cooking and heating appliances
June, fans

and so on during the year. We endeavor to have on exhibition and in operation every article mentioned in our advertising or spoken of by our canvassers.

Fourth—We endeavor during April of each year to give a week's practical demonstration of heating and cooking devices. In conducting a demonstration the chief aim should be to give it tone. The class of people you want to attend is not the class that goes to free exhibitions, and the class that goes to free exhibitions is not the class you want.

You first engage your demonstrators. It is better to have two and on their arrival lodge them in the leading hotel and have an interview or local notice in all the papers. Secure a hall that will seat about 200, if possible connected with some church or society. Build a small booth in the centre of the room and arrange the chairs around the booth. On the sides of the room have in operation every device that you can get your hands on. Trim the room and booth with flags, bunting and flowers.

First, great care should be exercised in the invitation lists. The invitations themselves should be in good taste, with no advertising features whatever, but entirely complimentary on the part of the electric company. Care should be exercised that the ladies of the same neighborhood should receive invitations for the same afternoon. Having two demonstrators, two meetings can be held each day, one at two in the afternoon and one at eight in the evening. The meetings take two hours or two hours and a half and begin with a short talk by one of the demonstrators or by the manager of the company. We interest the teachers in the manual training schools, and they very kindly assign sets of four girls for each meeting, who serve the guests. So at each meeting four different families become interested in electric cooking. After the *menu* has been served the guests are invited to inspect the various articles on exhibition around the rooms. The manager, superintendent and solicitors should be in daily attendance, one of them receiving the guests while the others should be ready to answer all sorts of questions. No effort should be made to sell articles on exhibition. Eliminate the business feature as much as possible and make it a purely and strictly complimentary social function.

This, gentlemen, is the outline of the campaign we are carrying on for new business. We propose to spend 3 per cent of our gross income on this department. We are getting satisfactory results. Increases of gross incomes of from 18 to 30 per cent, and in the case of one town of 8000 people 38 per cent increase. In every prosperous American city the electric business can be increased 25 per cent or more by a systematic effort, or, in other words, the electric business can be doubled every four years. A grave responsibility rests on our financiers, on our engineers. Can *we* go the pace?

R. W. Hemphill, Jr.

CO-OPERATIVE LIGHTING OF STREETS BY MERCHANTS

Since the time when arc lamps displaced the open-flame gas jet and gasolene lights there has been very little if any improvement in street-lighting systems, speaking of systems rather than of the lamps themselves. These systems did not produce the artistic or the illumination effect very much desired by the public.

Business men, as a rule, appreciate the benefit derived from something out of the ordinary, especially if it has strong advertising merits. If business men are public-spirited anything that will advertise the city in which they are doing business will appeal to them, especially if they derive direct benefit from it.

I will not enter into a lengthy discussion of the advantages to a city and to the merchants of ornamental street lighting, which must be apparent to all who have given this subject attention, but will give the methods employed in developing this system in St. Paul.

The co-operation of the merchants necessary to carry on a lighting scheme of this kind was accomplished by means of improvement associations. The plan in organizing these associations was for several prominent merchants on a street to call a meeting of the property owners and tenants on that street. At this meeting, after stating in a general way the plan of illumination, a committee was appointed to submit designs for posts, plan and location, together with an estimate of the cost. Two committees were appointed in each block, one on each side of the street, for the purpose of getting signatures from property owners and tenants agreeing to pay their proportion of the installation and maintenance expenses—it being understood that the property owners were to pay for the installation and the tenants for the maintenance.

A copy of the agreement used by the various associations in St. Paul is as follows:

Blank Street Improvement Association

AGREEMENT

We, the undersigned, owners of, and tenants occupying, property facing or abutting upon Blank street, in the city of St. Paul, in consideration of the obligation hereby assumed by each and all of us whose names are hereunto attached, do hereby agree to pay our *pro rata* share of the cost of installing and maintaining a system of lighting upon Blank street in accordance with plans to be submitted to us and at an expense to each property owner of not more than one dollar and fifty cents per front foot for installation, and at an expense to each tenant of same of not more than one dollar and thirty-five cents per front foot per year for maintenance.

NAME.	ADDRESS.	NO. FEET.
....	....	....

After the signatures of property owners and tenants were secured another meeting of the committees was called which authorized the officers of the association to contract for the installation and maintenance. The improvement associations have contracted with the foundries for the posts and with the St. Paul Gas Light Company for erecting, glassware, wiring, lamps, and so forth. The St. Paul Gas Light Company made an agreement with the associations to collect from the tenants for them the money for maintenance and to credit the amounts to the associations' accounts. Approximately 20 per cent more than the actual cost of lighting per foot is collected in order to provide a contingent fund to take care of accounts that can not be collected owing to vacant stores or tenants that will not pay. This contingent fund is to be rebated *pro rata* to the subscribers at the end of the year. The city pays the same amount for lighting that it paid under the old lighting system, thus reducing the cost to the tenants by the amount collected from the city.

St. Paul has at the present time five improvement associations that were organized for ornamental street lighting which covers about four miles of streets in the business district, being a total of 250 posts. This system is a radical departure from the methods employed heretofore. In order to have a good distribution of light and at the same time secure proper artistic effect combined with illumination, a plan was adopted of placing eight ornamental iron posts to each block, four on each side of the street, as shown in Figure 2.

Figure 1 is an illustration of the post. The top globe is light opal, eighteen inches in diameter, in which is one 50-cp lamp surrounded by five 10-cp lamps. The globes hanging pendent on four side-arms of the post have four 10-cp lamps each and are 12 inches in diameter, making a total consumption of 811 watts per post. It is the intention, however, to substitute high-efficiency lamps later. The 50-cp lamp in the top globe is on a separate circuit from the other lamps, for the reason that it burns all night while the other lamps are turned off at midnight. The lamps are operated from the Edison 3-wire network and are turned on and off by patrolmen. Two circuits are controlled by snap-key switches, the keyholes being in the base of the post, as shown in Figure 3. In order to provide for the heavy wind pressure against the globes, a brass collar is used around the neck of each globe to distribute pressure of the thumbscrews with which the globe is held. The wiring of the cluster is brought up through a pipe, as shown in Figure 4. Drainage is provided for any water caught in the top globe holder. The post is wired

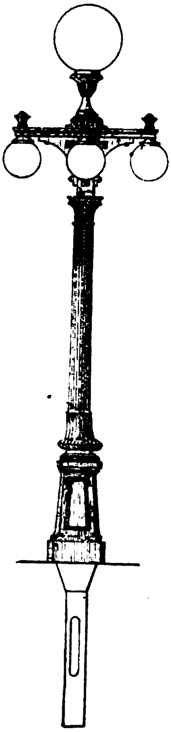


FIG. 1

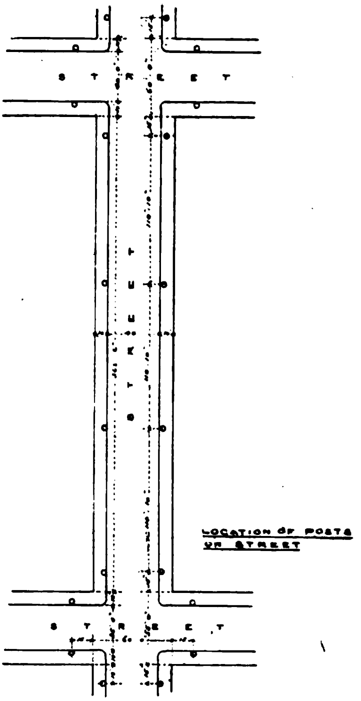


FIG. 2

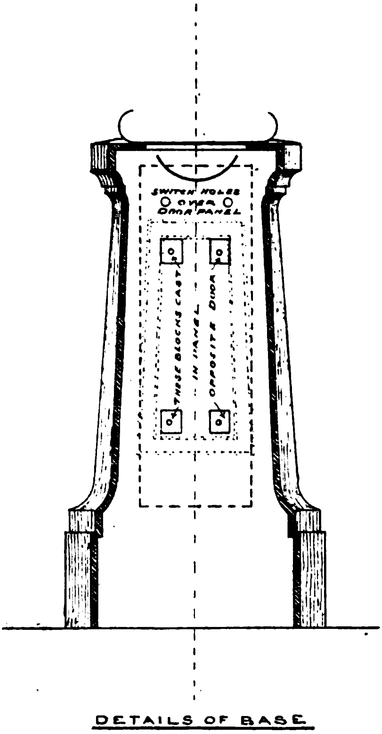

SWITCH HOLES OVER DOOR PANEL
THESE BLOCKS CAST IN PANEL OPPOSITE DOOR
DETAILS OF BASE

FIG. 3

1—LAMP-POST FOR STREET LAMPS
2—DIAGRAM OF INTERSECTING STREETS, SHOWING LOCATION OF POSTS
3—BASE OF LAMP-POST, SHOWING KEYHOLES

on the inside in circular loom, and connections to the underground mains along the street are made through lead-covered cable buried in concrete. The inside of the post is filled with concrete up to the level of the door in the bottom.

The cost for posts installed is $100 each, of which $55 is cost of foundry work and $45 for installation, connections, wiring, globes, and so forth. The posts are 14 feet high over all and extend four feet below the sidewalk, set in concrete. The post is all one casting, except the arms at the top, which are bolted on. The arms are 18.725 inches long from centre of post to centre of lamp cluster. The base of the post is 16 inches square by 30 inches high. The post below the sidewalk is 6 inches square and is provided with an opening for the cable.

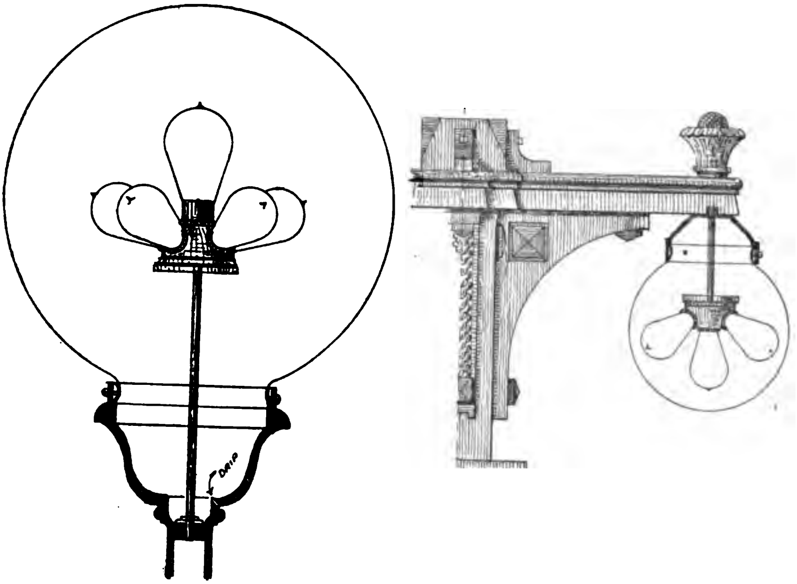


FIG. 4—SHOWING WIRING OF CLUSTER OF LAMPS AND DRAINAGE

The cost of maintenance and lighting is $101 per post per year. This is equivalent to approximately five cents per kilowatt-hour.

This uniform system of lighting has added much to the appearance of the streets on which it has been placed, without detracting from the window display and signs, which is quite important with any street-lighting system.

H. J. Gille

METHODS OF SECURING SIGN. OUTLINING AND WINDOW LIGHTING

When the new-business department of this company was started each solicitor had a portion of the business section for his territory, and the rivalry to secure results was keen. Window lighting was the first business gone after, as improvement along this line was along the line of least resistance; then outline lighting, which on two-year contracts was installed free; then signs were pushed. Care is taken to impress on the prospect's mind that any of these three forms of lighting should be considered an advertising, and not as a lighting, expense.

A flat rate was figured out, based on the Doherty system of charging and the actual number of burning hours as applied to Lincoln. Lights are turned on and off by us and burn from dusk until midnight each and every night.

We set a good example by outlining our building, lighting up the windows and installing the largest electric sign in town.

A good live prospect in each line of business was selected and worked upon until he lighted up. He was then used as a pacemaker for other merchants. When his rivals installed lights the pioneer in the field was induced to increase his display. It is a noteworthy fact that the merchants who use this form of advertising are continually increasing their original installation.

We used newspaper advertising, personal letters, mail advertising, starting in with one card a week, then two, and so on until the prospect received one each day for a week. This advertising was closely followed up by the solicitors. The mail advertising was neat, attractive and to the point, and served to put the prospect in a receptive mood, so that the solicitor could close quickly. Mail advertising and personal solicitation form a strong combination. It was a new method of advertising and created considerable favorable comment; the solicitors were persistent, but not annoying.

Solicitors are paid a small salary and a percentage of the gross increase in revenue over the corresponding month for the previous year. Each solicitor's commission depends on the number of points he has in proportion to the total number turned in.

and points are given for each dollar of estimated revenue, as follows:

	Points
Outlining, signs or window lighting until 12 o'clock	10
Less than 12 o'clock	5
If installed on meter	3
If the business is taken from the competing company the points are doubled.	

Each man is responsible for his territory and is keen to hold business as well as to get new business; it also follows that he is ambitious to get the business that pays him the most, and that is the desirable business for us.

Lamp renewals are free, and care is taken to see that burned-out lamps are changed promptly.

The signs installed here have all been built by a local firm, and their assistance in closing up business has been found valuable.

Our success in obtaining sign, outline and window lighting has been due to a rational method of charging, energetic solicitation, and a progressive class of merchants.

Homer Honeywell

Power

METHODS OF SECURING POWER BUSINESS

It seems to me our attitude toward the power problem should be that there is no reason why our plants should not furnish all the power used by manufacturers and others in the city, with possibly the exception of those manufacturers who use a larger amount of steam or heat in their process of manufacture; notably paper mills, who steam their pulp and use their engines simply as reducing valves.

An examination of the steam plant of the average manufacturer will show many examples of poor steam engineering and a high cost of energy delivered for actual production. One will usually find they are using comparatively expensive coal and frequently teaming the coal in and the ash out. They are probably purchasing their water from the city and feeding it to the boilers with injectors. The boilers are frequently poorly set and operating at poor efficiency. The engines are probably of inferior design, old and in poor condition; usually slide-valve or high-speed automatic, and in many instances either over or underloaded.

The frictional load of shafts and belts frequently will represent 20 to 50 per cent of the power produced. Their labor cost will be high when considering the amount of power actually consumed in producing useful work. It would therefore appear, with our high-efficiency generating plants, methods of burning low-grade fuels, low labor costs (due to large outputs and labor-saving devices), together with the savings we can secure by the elimination of a larger portion of the frictional line losses due to motor drive, that we should take over all the power business of the district, and not confine ourselves to a comparatively few short-hour, low-load-factor consumers.

As to some of the methods of attaining this desired end, I would suggest:

First—Secure the services of a good operating engineer for the work, a man, if possible, who has been in charge of a central-station plant, and one who can appreciate quickly the points involved in good and poor steam engineering. This man should be a good salesman, and with one or more assistants, can cover a good deal of ground by devoting his entire attention to the work.

There are many men operating the smaller plants who are admirably adapted for the work. The varied experience secured by such men in operating these plants, with the numerous difficulties encountered and overcome every day, makes them particularly resourceful and valuable for the work. I take my hat off, every time, to the man in charge of the average small central-station plant.

Second—Canvass of District. Have your power man make a thorough investigation of every power-producing plant in the district, no matter how large or small. Keep a systematic record of every case along lines suggested in plant data sheet herewith shown. A thorough study of each power problem should be made, which, supplemented with a study of the process of manufacture, will develop business that at first sight would be deemed impracticable to secure, owing to steam or fuel conditions. This analysis prepares the representative to meet the owner or manager, in a measure, upon his own ground, and having a close approximation to the total costs of the plant, conditions of operation and load-factors, puts him in a position where he can talk and argue most effectively. His grasp of the situation is tremendously increased. These records are invaluable, as in some instances it is not possible to close a prospect until he has a breakdown, and when it comes all the data are instantly available.

Third—Secure a Large Representative Installation. The first large customer comes hard. After the ice is broken, others have more confidence in your proposition and are easier to handle It will therefore be of great aid to secure one of these customers to whom you can send and take prospects. The customer should, if possible, be one of the leading manufacturers. There are always one or more manufacturers in a district who are naturally the leaders, and others are very apt to consider whatever *they* do the proper thing. Make the most important manufacturer your friend and a booster; make his installation a model one and you will find his aid invaluable. There is nothing so effective in arousing the interest and desire of a prospect as having him examine and see a large installation in operation, and talk with the owner or manager on the many advantages over the old steam drive.

Fourth—Trial Demonstration. We frequently meet prospects who are dubious as to the advantages of central-station drive in their particular business or conditions. They admit it is good for their neighbor, but for this reason or that, it is not suitable for them. In other words, they are from Missouri and "need to be shown." In these cases, I would install the complete equipment and furnish current to operate for sixty or ninety days' trial. Usually they will agree to pay a nominal sum, representing their acknowledged costs for the service and in many instances will further agree to provide the motor foundations and belts. Under these conditions the expense of such a trial is merely nominal, as all the apparatus can be removed and used elsewhere. There are many advantages in such a trial.

First: The organization of the local steam plant will deteriorate and in some instances vanish, so it is hard to get together another gang; the inertia of a change has been overcome and you have it on your side in finally closing.

Second: It demonstrates much better than you can tell the advantages of close speed regulation with its consequent increase in output; the freedom from plant troubles and worries, the flexibility and cleanliness, and above all gives you an accurate determination of the actual amount of power required to drive the plant under favorable conditions.

It has been the writer's experience that fully 95 per cent of these trial installations are finally closed.

Fifth—Methods of Selling. Be liberal with your prospects in regard to terms of payment for the motors. In many instances it is advisable to sell upon the instalment plan and allow one or two years to pay for the installation. The small manufacturer especially needs the money in his business and can not afford to make the necessary outlay in cash for the proper installation. By taking a lease upon the apparatus and insuring it against fire, you are pretty well protected. In some instances it may be necessary to install a motor free, if it secures a particularly favorable business. The rate per kilowatt-hour can be easily increased enough to cover the cost of the motor. In other words, allow nothing to stand in the way in the line of a reasonable investment in securing good motor business.

Sixth—Remember every power prospect, especially if it be a large one, must be considered largely as an individual proposition. You can not make a hard and fast system of rates which will apply to all cases. Do not be afraid to go down on high-load-factor business, simply because your present cost with its low load-factor is higher than perhaps you will be called upon to quote. I would suggest dividing your costs up into readiness-to-serve, and output expense; dividing the connected load into the total readiness-to-serve expense, and the output expense by manufactured current. This will give an indication of the value of high-load-factor business and what it can be sold for. Therefore, do not be afraid to go down on the long-hour business.

OFF-PEAK BUSINESS

This class of business does not seem to have been given the consideration it deserves. Many stations believe it is not possible to secure any amount of this character of business. If, however, every power prospect be carefully analyzed and working hours studied, it will astonish you to find how much business can be secured on this basis. Wherever a manufacturer works two shifts it is usually possible to so arrange the hours that they will avoid your six o'clock overlapping peak. The proposition requires care in presenting to the manufacturer, for at first thought he will say that it is not possible, but if your man has his conditions thoroughly in mind (and he should not talk until he has) he can in many instances persuade the prospect to shorten the noon hour, start one-half hour earlier in the morning and shut down early enough during the winter months to avoid the overlap. For instance, flour mills can easily shut down during overlapping peak hours, foundries by getting out their iron somewhat earlier, and many others are in the same class. Flat rates in connection with this off-peak business work in very advantageously. I am aware of the prejudice of all central stations against flat rates and to some extent I share this for unlimited flat-rate lighting. However, I do not believe flat-rate power business is in the same class. The manufacturer will not pay for labor or wear and tear upon machines simply to waste current. He has a clearly-defined number of hours to operate, a certain maximum production to obtain in these hours, and a definite number of machines to operate. A contract can thus be easily drawn which will cover the situation fairly well. Sample of this flat-rate peak-load contract is herewith shown. You will note it says nothing about the horse-power required. The company merely agrees to furnish energy in sufficient quantities to drive a certain number of carefully-described machines a certain number of hours per day. This contract is very useful in landing certain classes of men and business which could not be otherwise obtained.

The value to the central station of a good, heavy, long-hour motor load can not be overestimated. It furnishes a steady income for every month of the year. The amounts received per customer are relatively large and difficulties of collection very small. This power business will represent a satisfied class of customers, the most influential and best element of the city, and they will influence public opinion in your favor and largely minimize the danger of municipal ownership agitation.

George N. Tidd

CATERING TO POWER FOR AUTOMOBILE CHARGING

Responding to the very urgent request of Mr. J. Robert Crouse, chairman of the membership committee of this association, to write a brief paper on the subject of *Catering to Power for Automobile Charging,* I suspect that after a thorough search of the electric field, Mr. Crouse must have congratulated himself in the end on having found a victim who would consider even briefly this, at best, rather dry subject. Therefore, to lend what assistance I may, I will outline what is being done in Hartford, Conn., in this line.

Several years ago we were led to believe that the horse would soon be a prehistoric animal, and that the electric-hydrant, nickle-in-the-slot principle, "charged while you wait," would prevail. Then followed the experience with exhausted batteries and windless tires, and the horse is "still with us."

In past years the use of electric vehicles has been limited, owing to the fact that the direct-current system of the Hartford Electric Light Company covers a territory of only about one-third of a mile from the point of distribution in the centre of the city. A demand was immediately created for a low-priced device for straightening the alternating current, enabling the charging of batteries in the alternating-current district. In this age of modern scientific skill and progress, this demand was promptly met by the advent of the mercury rectifier, which is now used quite extensively and is not a new feature to the members of the National Electric Light Association.

November 25, 1904, the Hartford Electric Light Company ordered 10 of these mercury rectifiers and since then has placed successive orders from time to time until, at the present time, we have in use on our alternating-current system 44 of these equipments, which are giving excellent satisfaction. The gross receipts during the year 1905 from both the alternating and direct-current systems for charging purposes were $3,381.81; for the year 1906 these gross receipts were $4,441.90. In these amounts all the garages are included. Of these gross earnings, $1,402.24 in 1905 and $1,496.06 in 1906 were derived from a flat charge for the supply of electric current, together with the maintenance of batteries for three electric vehicles, two of which belong to the police department (one ambulance and one police patrol wagon), and the third, a 'bus belonging to the Hotel Heublein. We made contracts with these people, agreeing to manufacture for them their batteries complete for one-half the cost of same to us and to supply charging current and maintain the batteries at a cost to them of $1.75 per day for each vehicle for 365 days per year. This scheme has proved to be a very profitable one to us and very satisfactory to our customers.

A scheme of this kind, however, would not appeal to nor be practicable for central stations that do not have in their employ skilled battery men. The Hartford Electric Light Company has floating on its direct-current system a large battery having an initial rated capacity of 17,000 ampere-hours. The men employed for the up-keep and maintenance of this battery manufacture the batteries above-mentioned as well as construct the batteries used in our own vehicles, of which we have at present one truck, three construction wagons and three runabouts.

These batteries are manufactured under a patent owned by the Hartford Electric Light Company. Pure lead is bought in the form of lead wire three-eighths inch in diameter, cut into the proper lengths, and these lead strips are passed through a die which gives the desired surface. These parts are then burned together, forming the plates, after which the plates are electrochemically formed. This experience has been most satisfactory to us, one especially valuable feature being that these batteries are not injured by overcharging, and the cost to us of a battery of a given capacity is much less than such batteries purchased in the open market.

We have in use in the streets of Hartford approximately 75 electric vehicles. The Electric Vehicle Company of our city is manufacturing an exceedingly pleasing and artistic line of pleasure carriages of the runabout and victoria type, the victoria type being looked upon with special favor by the ladies, many of them being seen daily running their own carriages through our picturesque streets and parks.

To ascertain what is being done with the mercury rectifier in other central stations, I sent out a list of questions to 30 representative companies, and 11 of these companies responded, but the information obtained was very limited and very little enthusiasm was expressed. The gross receipts recorded by those who responded to the questions ranged from $1,200 per annum down.

The current cost for the operation of electric runabouts is very small. The average cost of current consumed for 17 pleasure runabouts in the city of Hartford for the year 1906 was $3.19 per month, among these customers being several doctors who wish their vehicles ready for service at all times.

In conclusion, will say that no special advertising or soliciting has been carried on by my company. We have one of the mercury rectifiers on exhibition at our store, together with other show-room devices, and these attract considerable attention.

Thus far this year the call for charging equipment very materially exceeds the record for the past two years, and I feel confident that automobile charging will in the near future become quite a prominent factor in central-station power business.

Robert W. Rollins

ESTABLISHING DAY CIRCUITS IN TOWNS OF 10,000 POPULATION AND UNDER

If we look over the list of central stations in the United States we shall find many cities of between 5000 and 10,000 population that are not yet receiving the conveniences of a 24-hour service, and if we extend our investigations to towns of less than 5000 inhabitants we shall find that a continuous electric service in such towns is practically unknown.

The possibilities of the smaller locality have been overlooked or neglected until to-day the average central-station management is honest in the belief that a day service in the little town is impossible. While we will admit that the average electric company operating in a small locality has a precarious existence, we shall still contend—and there are examples to prove the contention—that the companies themselves are entirely to blame for such a condition, and that the communities at large can in no way be held responsible. Be that as it may, the small communities are rapidly awakening to a knowledge of their rights, and are beginning to demand in no uncertain manner that their needs and conveniences be considered and that electricity be placed on a par with gas and water, and its distribution throughout the 24 hours be made universal. As a business proposition, it is good policy to anticipate a request rather than to comply with a demand, and we, as public-service companies, should meet the question promptly, and then see to it that we make the new operating condition a profitable one.

The question as to whether a given community can or will support a day service is merely an excuse for delay, and a very poor one at that, for there is no doubt but that any community that can maintain an electric-lighting plant will support the additional service if such support is sought. It is this phase—the seeking for profitable new business by a small company that has already undertaken the task of maintaining a 24-hour service in a town of less than 1500 population—that I will attempt to describe.

Generation is by gas engine, using natural gas. Competition—coal at $3.40 delivered, and natural gas for all purposes at 25 cents per 1000 cubic feet.

No public contracts, being dependent upon commercial work alone.

Earnings at time of beginning of day service—May 1, 1904—somewhat less than $4.00 *per capita* per year.

With these conditions, it was determined, for various reasons, that a 24-hour service should be attempted, and with that in view future plans were laid.

As to rates: A sliding scale on the basis of the number of hours' service was decided upon, with some variations. This rate is:

7.5 hours	20 cents
7.5 “	10 “
15.0 “	9 “
30.0 “	6 “
30.0 “	3 “
All after	2 “

or seven cents for a three-hour service and two cents thereafter, with no minimum, no meter rental, and free renewals.

The constant to determine the hours of service was, in practice, neither the actual maximum demand nor the maximum rated load installed, but a figure based more particularly on the area to be lighted, and approximating 0.75 watt per square foot of floor area. A customer was allowed to install as many and as large units as might be desired, the one using the large candle-power per square foot paying a much lower rate for his current than the more economical customer who preferred small illumination. The object was to encourage or force free use of current, and the rapidly falling rate was to enable long hours of service economically. It has done the work well, the average output per month being 20,000 kilowatt-hours for a 250-kilowatt plant; average return to company being five cents per kilowatt-hour gross and one and three-quarters cents per kilowatt-hour net.

Free wiring has been done for some years, and it was decided to extend this principle to any and all equipment that a possible customer might desire to make use of in connection with the new service, but to make such installations on a rental basis, and a charge of one cent per month for each dollar invested was decided upon. This method has been highly successful with the company, and under it are included all classes of mechanical equipment, as motors, shafting, pulleys, belts, wiring, lighting fixtures—except arc lamps, for which no rental is charged—heating utensils of all kinds; in fact, everything that will assist in the increased sale of current. The only contract that is required on such installations is one showing the itemized ownership of same and the rights of removal at the company's option. The extent to which this plan has been followed is shown by the fact that, of the 370-odd service taps connected to the lines, nearly three-fourths of the feed installations belong to the company. The service is as nearly high-grade as most cities maintain, and this is best proven by the fact that during a two-year bitter franchise fight between the company and the town not one word has ever been said against it.

Advertising: Very little money has been spent in the usual forms of advertising, and while there is no doubt as to the great value of printed advertising in large places, where the public must be reached indirectly, the fact that in small localities the person doing the soliciting is, or should be, personally acquainted with every person in the territory, renders this form of advertising unnecessary. Personal work is so far preferable as to eliminate all value from paper or circular publicity. This personal work may take many forms. For instance, the electric company can, with profit to itself, become the consulting engineer for all mechanical enterprises in its field, even though at the time there may be no opportunity to gain any additional service thereby. Furthermore, if an illuminating engineer is almost a necessity in a large city, how much more important is some knowledge of that art in a little town where they have no conception whatever of colors and light, and but one large idea—that of getting lots of light for very little money.

Installing service on trial is another form of effective advertising. Trading in equipment that your service renders unnecessary is another, and an excellent form, for you thereby eliminate such equipment as a possible future competitor. Along this line it has been the practice of the company to dismantle gas or gasolene lighting outfits as soon as electricity was installed, and in this way to do away with a future possibility that was unpleasant. The policy of the company has been to take special pains to secure the little customer, both lighting and power, and it has never refused to place its service in premises on any demand of 16 candle-power or over. The result of this is that gas lighting has been eliminated, and that even the great Standard Oil Company has acknowledged the effect of the company's efforts on its business by sending one of its special agents into the town to see where the oil sales were going to.

Flat-irons are especially profitable as day load, and with something over 60 irons in service the company can claim a new kind of peak load. This strikes the station about ten o'clock on Tuesday morning, and on a hot summer morning has been known to reach over 150 amperes above normal, lasting, with a drop at noon, until four or five o'clock. On more than one occasion this load, coming as it does with the motor peak, has necessitated a second engine on the load. Although using very little current singly, yet collectively sewing-machine and washing-machine motors are extremely good current salesmen.

The company has been making experiments as to rural service, with a view of extensive work in that line, having six miles of such lines in operation, supplying a 24-hour service, with same conditions and rates as apply within the corporation. Fifteen motors, aggregating 50 horse-power, and about 150 lamps are connected with these lines, and the results are very encouraging. In all, the company has at present connected to its lines 7000 incandescent lamps of all sizes, 45 incandescent arc lamps, and 90 horse-power of motors, earning, on a capitalization of $15,000, no bonds, an average income of $1,000 per month in a town of less than 1500 population.

In conclusion: The company would recommend, from its own experience, that some form of demand system of rates be used; that great energy be expended in securing many little customers; that some form of free installation of equipment is desirable; that a personal rather than an impersonal form of advertising be used, but that the advertising allowance be of liberal proportion to the income; that co-operation in everything electrical is to be desired; and that the little company should by all means join the associations, both state and national.

F. H. Plaice

Heating

COMMERCIAL METHODS OF EXPLOITING ELECTRIC HEATING APPLIANCES

I approach a discussion of this subject with great diffidence, as I know that there has been but little that is unique in our methods of introducing this type of appliance to users of electric current. I am, however, emboldened to write this paper—which is written along the lines of an "experience meeting" rather than along general lines—because we have had some considerable success in the introduction of electric irons.

The Mobile Electric Company was purchased by Messrs, H. M. Byllesby and Company, of Chicago, in 1906, and actively taken charge of in June of that year. At the time of the purchase of the properties now consolidated as the Mobile Electric Company, there were not two dozen electric irons in use in the city of Mobile. Incident to the large work of reorganization there was no opportunity to engage actively in the development of a new-business department until August of 1906. In August, 1906, a campaign was started looking to the introduction of electric irons. This campaign was started by extensive newspaper advertising for the first 30 days, making a 30-day free trial offer. This was followed up by canvassers being sent from house to house, leaving electric irons wherever possible with a request that they be tried, and if in any wise unsatisfactory, either on account of practical inefficiency or high cost of operation, be returned when called for by the solicitor. The only thing required from the consumer when the iron was left was a receipt for same which called for payment of $4.00, the price of the iron, at the end of 30 days, or the return of the iron. Conjointly with this the literature of a well-known advertising company was sent out very freely, and the results have been very pleasing. Since August and up to April 30, 640 electric irons have been accepted and paid for by the consumers of this company.

The class of solicitors employed in this work has not been of the highest. At no time was there more than one man engaged in this work, and only for a period of about 30 days was his time exclusively devoted to canvassing for electric irons. The man—or boy, rather—received $45 per month as salary. During the time that he was putting out irons he placed on an average 20 irons a day. Of these irons, 805 were accepted; the rest were returned, burnished up and redelivered. While the number of irons accepted originally by the consumers at whose premises the irons were left averaged about 80, the real average of the ultimate users of these irons was higher, as in many instances irons were returned and subsequently the same people called at our office and purchased new irons.

We have one laundry in this city that operates entirely with electricity. Not only is electric power used as a motive power, and electric irons used for ironing, but the rolls on the larger machines are all electrically heated. This laundry at the present time uses about 35 irons. We have another laundry that is using 18 irons. This is the only electric equipment outside of the lighting that the second laundry has. Solicitors for this latter class of work come under the head of power solicitors, as for this class of work a much higher grade of solicitation is required. The company, in order to introduce the iron into these laundries, itself took its chances of the success of the installation: that is to say, it offered to install these irons, paying for all the wiring and furnishing the irons free on a 60 days' trial, the irons and wiring to be paid for should the laundry decide to continue the use of the electric irons. In one of these laundries a rate of two and three-quarters cents per kilowatt-hour was made, and in the other a rate of three cents per kilowatt-hour was the contract price.

These rates made the cost of electric ironing, as compared with heating the irons by gas, about 205 per cent higher than the cost of gas, but the owners of the laundries assure us that four of their girls can turn out as much work with electric irons as five could turn out with the irons heated by gas or other methods; it therefore pays them to use the electric irons. Aside from this it was found that there were fewer garments scorched or under-ironed with electric irons than when using irons heated by other methods. As indicated before, for this latter class of work a very much higher grade of solicitor is required. A man must be used who is not only a ready talker, but who can intelligently explain the various features, and one who is sufficiently conversant with electricity to discuss it in a semi-technical manner. In this connection I wish to say that I feel it a mistake to employ a solicitor who is too thoroughly acquainted with the technical end of his business. This applies even to solicitors of electric power, as in practice such a man invariably talks over the heads of his prospective consumers and not with them. He continually uses terms that are so familiar by association to himself that he does not realize that he is using technical terms, and the consumer is frequently more or less ashamed to confess ignorance of the exact meaning of the terms employed and will frequently nod his assent to arguments that he does not understand.

We have not, up to the present time, succeeded very well in our efforts to introduce electric-cooking devices. We have introduced about six dozen cooking devices of all kinds, the greater part of which were milk-warmers. We have introduced a number of waffle and gridirons and chafing dishes. One set of waffle irons in a hotel is working with entire satisfaction to the proprietors. We attempted to introduce cooking stoves by presenting one for a free trial to a consumer, but were unfortunate in the results obtained. We are just preparing to start an active campaign along this line by newspaper advertising and personal solicitation. Whether or not we shall succeed in our efforts, we, of course, do not know.

To sum up: In our campaign looking to the introduction of heating devices we have introduced no methods that might be termed new. We have merely put into practice the very excellent suggestions that we have obtained from a publication of an advertising company. We started in with a newspaper campaign, followed this up by personal solicitation and advertising matter sent out by one of the well-known advertising companies, together with an effective window display. Our windows were decorated to represent a high-class dining-room with the usual sideboard, dining-room table, carpets, pictures, cut glass, and so forth. On this dining-room table was placed an ironing board, and we installed a girl with a white gown ironing with one of our electric irons. We placed a placard in our window with this statement:

"SHE DOES NOT HAVE TO WEAR HER OLD CLOTHES TO DO HER IRONING."

The ideas contained in the publication of the advertising company were all practical and valuable, and we predict success to any company that puts same into actual practice.

In employing solicitors for all classes of our work there is only one injunction that we thoroughly impress upon them—that is, we tell them we are not paying them their salary, but that their salaries are paid by the consumers of the company. We are merely acting as a clearing-house, and their business is to look after the interests of the consumers and not after ours. We will take care of ourselves; their entire duty consists in obtaining the best and most out of us for their consumer's company. Having imbued this idea thoroughly, we find little difficulty in getting efficient results out of our solicitors.

Our contract department consists of three men besides the man at the contract window. One man on power, one man on store illumination and signs, one man on residence lighting and electric irons.

Our power department has contracted an average of 185 horse-power per month since its organization. Our sign department has increased our business by $7,200 per year of flat-rate signs since January 1, 1907. The total number of contracts written from January 1; 1907 to April 1, 1907, was 650; this in face of an increase in lighting rates.

The population of Mobile is between 60,000 and 70,000 inhabitants.

Theo. K. Jackson

CHAIRMAN FREEMAN: If any one thinks anything has been omitted in these papers, now is the time to make the correction.

MR. RAWSON COLLIER (Atlanta, Ga.): In Atlanta we have just placed an electric milk sterilizer on the line—15 kilowatts at 2200 volts—and I have been informed by the city physician, who made experiments on the milk after it was sterilized, that there were no germs present, none of the food properties were in any way injured, and the milk was perfectly sweet six days after sterilization. The milk sterilizer is not operated between five and eleven o'clock at night, its operation not affecting the voltage regulation at all. We get power rates for the current.

MR. MANNING: In the matter of special rates, which Mr. Scherck said were so objectionable, I know where a strict adherence to a uniform rate has proved most successful. In the city of Flint, Mich., a rate of 10 cents per kilowatt-hour for the first $25 worth of current is charged, then 7.5 and then five cents, and there are 1600 customers in this city of 15,000 population, from whom is obtained better than $4.50 *per capita* for lighting and power. Power rates are five cents straight, no discount. One man does all the meter reading and all the collecting for 1600 customers, and they carry over from month to month less than $400.

MR. E. F. McCABE (Lewiston, Pa.): I ask Mr. Plaice if he can tell what his largest customers pay him?

MR. PLAICE: We have one customer—a sort of combination customer. There were some six stores, combined into an arcade, forming a $60,000 concern, and they contracted with us for lights and use a minimum of $900. They do not exceed the minimum. The next largest customer is about $150.

MR. TAIT: Mr. Plaice states that there are 370 service taps. How many buildings are supplied? I understand you use special machinery to promote a day load. I believe you milk cows by electricity. What do you do on Sunday when the day load is small? Do you operate the plant? If so, what kind of load have you?

MR. MANNING: I ask Mr. Plaice on what basis is his average rate of 12 cents per kilowatt-hour—is it connected load or maximum demand?

MR. PLAICE: We are lighting 85 per cent of the buildings in town. We have as many service taps as buildings, but that is explained by the fact that some of our customers have two or three different services. We have customers for lighting service who also use current for power; a number use it in their stores and in their residences as well, and they are all separate. That is how the large number of services comes in. In addition, we have quite a number of country line services, which runs the number up. There is nothing but electricity in use for store lighting, and that is supplied by us. We have not yet got all the coal-oil lamps out of residences, but we hope to do so eventually. We secured an application for a 10-hp motor from a customer who wanted to use it a mile and three-quarters away from the station. The generating plant was for 125 volts, and we could not reach them with that voltage. We decided to install a 550-volt generator, and put them on that. We did so, and it was only a short time before some one further out made an application for current, and it spread until we had three lines running out from the town, covering a radius of about five miles. After deducting all the cost of current at the actual cost to us, interest on the investment, and allowing 10 per cent for depreciation, our country lines last year cleared 40 per cent. We use bare wire, and on the lightning end we wire up two 250-volt lamps in series, switches on each pair of lamps, fuse boxes outside of buildings, and do not get more than one ampere in circuit. Every installation is protected by kicking coils and lightning arresters. All power motors are also protected in this way, except the small ones close to the station. We have 60 pairs of lightning arresters, and thus far we have never been shut down by lightning, although our neighbors have.

One of our dairy farmers last June bought the first electric milking outfit that was installed in the state of Ohio. It took three men three hours to milk 50 cows, and this was repeated night and morning. The milking machine milks four cows at a time, and milks them all in one and three-quarters or two hours. It costs about $6.00 a month for current, so the farmer is satisfied.

Our Sunday day load is small. It doesn't make any difference whether we have any load or not; the engine goes just the same. At first we tried running 20 horse-power on the load, and we found that once in a while the big farm motors would be slapped on us on Sunday, so we maintain the same service on Sunday as on week days.

Our rate is not based strictly on the maximum demand of the customer, or the maximum demand that would be possible if he used the connected load. One trouble has been to get customers to use lamps large enough and enough of them. We want them to use plenty of light. When a customer has poor light and not enough of it, he will blame the company. There is another thing—we take a 4-watt lamp at 110 volts and burn it at 120 volts. Instead of the customary 16 candle-power, the customer gets nearly 22 candle-power, and he also gets, instead of four watts, an efficiency not far from three watts. A 4-cp lamp under that condition will give about six candle-power; 8-cp about 12, and 16-cp about 22. When it comes to motor business, our constant, which we take and divide into the meter reading, gives us the rate to which the customer is entitled. Suppose a customer has a constant of 10 and uses 15 kilowatts, you get 1.5. He would be charged for 10 kilowatts, or one hour of service, at 10 cents, and the other five kilowatts would be charged to him at six cents, which makes his total bill. If he uses current until he passes the two-hour mark we charge two hours at nine cents, and all in excess is charged at three cents until he reaches the three-hour mark, when he is charged at two cents.

MR. F. W. BULLOCK (Jamestown, N. Y.): I should like to ask Mr. Plaice if he has much trouble in the form of competition from natural-gas engines for power and gas mantles for lighting; also as to the quality of the gas as to B. t. u. per cubic foot. I should also like to ask if he can furnish electric power at two cents per kilowatt-hour to compete favorably with natural gas at 25 cents per thousand cubic feet, for large power users.

MR. PLAICE: We have no further competition in gas lighting. The gas company is licked completely; we have not got a gas light on our line. There is one isolated plant in our town—a factory—which uses lights, possibly, only 15 nights in the year, which is likely to come on in the holiday time. We did not care for this load. For their day service they burn gas. We did not want to take their business. There are several gas engines of larger sizes in the town, but none of small size. Up to the present we have catered exclusively to the small trade. We have to-day applications filed for something like 300-hp load, in large blocks; two of them would be 125-hp blocks. One of these firms did at one time use gas engines. There is one gas engine on the list —25-hp—which we shall probably take on. We have had to fight for our rights for two years. The town says we have no franchise, and we claim that we have one, and until that is settled we can not do very much.

MR. GILCHRIST: I move a vote of thanks to the publishers of the *Convention Daily*. I think they have rendered an excellent service to the National Electric Light Association this year.

(The motion was carried.)

CHAIRMAN FREEMAN: I wish to congratulate the meeting on having accomplished its work within the prescribed time. I feel that we have in this compendium of commercial papers such a variety of papers as has never before been gathered together under one cover—a compendium that it would be difficult to duplicate, and one the value of whose contents will become increasingly apparent to us as we study them. I thank the gentlemen for their attention.

(The commercial meeting then adjourned.)

Question Box

PAUL LÜPKE, *Editor*

ERRATA

1907 Question Box

National Electric Light Association

Page 5, Question A 4. The sentence "Concrete must be handled carefully and kept covered with salt, hay or," etc. The comma should be left out after the word "salt," as the reference is to *salt hay*.

Page 137, Question P 30, reading, "With transformers Y-connected the voltage on each primary coil is one-third or 57.7 per cent of the line e. m. f.," should read: *With transformers Y-connected the voltage is* $\sqrt{1/3}$ *or 57.7 per cent of the line e. m. f.*

Page 254, Question U 42. The sentence "The dial mechanism of the meter is really a device for recording the revolutions of the bicycle wheel," should read as follows: *The dial mechanism of the meter is really a device for recording the revolutions of the disc, just as the cyclometer is a device for recording the revolutions of the bicycle wheel.* Also, further down in the same paragraph it reads "and multiply the number of this value (constant) in order," etc. The word *by* should be substituted for the word "of" and this should read: *and multiply the number by this value (constant) in order,* etc. This answer should be signed *Geo. Ross Green, Philadelphia Electric Co.,* and not signed "The Philadelphia Electric Co."

All answers signed "Geo. Ross Green," except the answer to U 42, should be signed *The Philadelphia Electric Co.*

INTRODUCTION

In the introduction to last year's issue I ventured to suggest that perhaps some better way might be found to carry on the work the Question Box *is intended to cover. Within the past month a circular issued by the American Gas Institute has been brought to my notice, and I am free to express as my opinion that the plan outlined therein is superior in some ways to our present method of handling this subject.*

Briefly, this plan is as follows:

A Bureau of Information is formed, composed of six members, among whom the different subjects to be covered are divided. The method of proceeding is given in this paragraph quoted from the circular:

"The members are invited to send to the Secretary *all questions to which answers by the Bureau are desired. The Bureau will not attempt to do the work of a consulting gas engineer. It will in many cases rather attempt to indicate methods of solution than actually solve the problem given. Where satisfactory answers already exist to questions asked, the questioner will be directed to these answers. Where the questions are incapable of a positive answer, the questioner will be so told. Where the matter is plainly one for a consulting gas engineer, the questioner will be advised to employ one.*

"All questions and answers that may be deemed of value to the membership in general will be recommended by the Bureau to the Directors of the Institute for publication in the Proceedings."

It is entirely feasible to embody in this plan a feature that would admit of having all questions of policy or opinion sub-

mitted to all members, so that this valuable feature of the present plan of the Question Box *would not be lost.*

In presenting the present volume I must once more pay due tribute to the tireless co-operation of Miss Harriet Billings, our assistant secretary, and I must again express my thanks to Mr. E. C. Stahl, Jr., and Mr. Clarence A. Hutchings for their efficient help.

PAUL LÜPKE,

May 25, 1907. *Editor.*

Question Box

OF THE

Thirtieth Convention of the National Electric Light Association

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A—BUILDINGS

A 1. From a practical viewpoint, does concrete make good substation buildings?

The only objection is large size of columns and beams necessary, requiring additional room and making wiring layout more difficult.

J. T. Whittlesey.

The writer believes that, from a practical viewpoint, concrete makes an excellent substation building.

F. C. Sargent.

Concrete-block construction makes a very fair substation, depending upon conditions and design.

H. B. Gunnison.

It certainly does make a very substantial building.

Walter Flint.

A 2. Does concrete construction pay on larger buildings with considerable height?

Not if walls are high without intermediate floors. Concrete is cheaper for warehouses and shops of several low-ceiling floors.

J. T. Whittlesey.

Concrete walls with two surfaces to be made by molds cost more than brick walls, while concrete floors are in general cheaper than fireproofed steel-supported floors. If excessive vibration or earthquakes are expected, the all-reinforced concrete building would be advisable; but if not, the concrete frame with brick curtain-walls will be cheaper and in general more pleasing in appearance.

G. L. Bennett.

A 3. Is concrete piling satisfactory? How does cost compare with wood piling?

Yes. Cost per pile is three or four times that of wood, but it supports greater load. In some cases total cost is less.

J. T. Whittlesey.

See *Engineering and Contracting,* vol. xxvii, April 10, 1907, *Method and Cost of Repairing a Pile Trestle;* also, vol. xxvii, February 13, 1907, *Method and Cost of Driving Raymond Concrete Piles for a Building Foundation.*

H. B. Gunnison.

In recent years it has become common practice to use concrete pilings, either plain or reinforced, as they have comparatively greater carrying capacity and durability and, further, they may extend far above ground water; when the wooden piles are used, their heads must be cut below ground water, and thus deep excavation may be necessary, to which point the foundation must be carried down.

The relative cost of each depends largely upon the location in which they are to be used.

S. C. Foster.

A 4. Is it safe to do concrete work in the winter-time in cold climates? What will prevent the concrete from freezing and crumbling?

Concrete construction in freezing weather is something of a gamble, even with the best care and material. Effect on concrete made with Portland cement is much less serious than on natural-cement concrete. If fresh concrete is frozen and stays in that condition for weeks, there will probably be no injury if it has plenty of time after thawing to harden before it is again subjected to cold. Alternate freezing and thawing daily will produce poor stuff cracked on the outside and with no cohesion within. Even this will do for great masses employed to obtain weight or as a backing for stone-masonry, but will not do where the construction requires uniform strength throughout. It is necessary to keep such fresh work warm. When it is in large masses, roof over and warm with steam pipes. For building construction close all window openings with curtains; cover floors, as soon as poured, with planks, panels raised six inches above top of floor. Heat with salamanders. Steam is used to heat sand and stone and also to heat and dampen air in enclosed space. Use quick-setting cement, warm sand and stone and sometimes salted water. —[From *Engineering Record*, December 22, 1906.—Ed.]

Yes, with proper precautions. Our company put in part of a concrete flume in zero weather. We heated the sand and gravel and used hot water. The walls were carefully protected by a foot of manure. The part put in during cold weather is as good as that put in earlier in the season. The flume is now more than three years old.

P. H. Korst.

In order to prevent concrete from crumbling when mixed in freezing weather, salt is added to the water; both sand and water are heated before being mixed with the concrete. Concrete must be handled quickly and kept covered with salt, hay or horse manure, if surface is to be exposed for any length of time. In this way perfect concrete work can be done in cold weather.

Geo. Ross Green.

Almost anything can be done safely if one will outlay sufficient money and care. Under conditions of expected cold weather and sufficient demand for the building, the site has been enclosed with a cheap, outer, temporary, light board structure, and building operations prosecuted inside when outside temperature ranged from 20 to 40 degrees below zero, Fahrenheit. Temperature inside was kept up by means of fires, and scaffolding was supported at its outer end on this wooden structure. For temperature but little below the freezing-point the use of warm water and heated stone, and sometimes salt in water, will prevent freezing until the concrete gets its initial set. Concrete should be protected immediately it is placed, with hay, straw, bags or sand.

G. L. Bennett.

Concrete work can be done in winter-time or in a very cold climate if salt or steam is used on the material before placing in position.

Walter Flint.

A 5. What kind of roof is advisable for a fireproof plant?

Reinforced concrete.

J. T. Whittlesey.

Two thicknesses of corrugated galvanized iron, supported, of course, by iron structure.

Wm. M. Lewis.

There are several good forms of cement roofing that can be used on a fireproof building.

Walter Flint.

Reinforced cinder-concrete or reinforced concrete and tile has proved entirely satisfactory; our roofs are supported by steel I-beams. Spans of reinforced concrete vary up to 12 feet.

H. B. Gunnison.

A 6. Has a satisfactory treatment been found to render cement floors dust-free and oil and waterproof?

Have found nothing that was absolutely dustproof, but a treatment of paraffin put over the floors was about the greatest help. This was also recommended to and tried by a large woolen mill and was found of great advantage.

Wm. M. Lewis.

I do not know of any cement floors that are void of dust unless they are soaked with oil (linseed) occasionally, and as for being oil or waterproof, we have nothing here that is either. Most of our engine-room floors are cast iron.

J. J. Chrisholm.

Yes. We have had a good deal of trouble with the cement floors in the physical laboratory building at Lehigh University (South Bethlehem, Pa.). The surface of these floors became roughened with wear and the resulting dust became an intolerable nuisance. In our dynamo laboratories the dust settled on commutators and bearings and thereby increased sparking at the brushes and wear at the bearings. About three years ago my attention was called to a treatment (a filler and paint) especially adapted to cement floors, which treatment I had applied to the cement floors of several rooms, including our dynamo laboratories. After three years' trial I can say that this preparation, made by Toch Brothers, has given us very satisfactory results. It has eliminated the dust nuisance, and it also seems to be practically oil and waterproof.

William Esty.

We have used a special kind of paint on our power-station floor, which has given good satisfaction. It consists of resinous liquid which takes up the lime and permeates the cement. A second coat of similar material containing a pigment is used for finishing. This paint makes the floor proof against oil and water and prevents the cement from wearing off and becoming dusty.

The paint is made by Toch Brothers, of Long Island City.

Geo. W. Stone.

Our floors are rendered dust-free, also oil and waterproof, as follows: After cement floor has been set about four weeks it is given two coats of sizing (a cheap grade of varnish), then two coats of any desired color of lead and oil added. This method has been used for three years and has proved entirely satisfactory.

H. B. Gunnison.

A 7. Under what circumstances is it advisable to use metal window-frames and wired glass in power-plant construction?

The use of metal window-frames and wire-glass in power-plant construction is advisable in all buildings of so-called fireproof construction, when the outside fire hazard is great.

N. A. Rollins.

In stations where there is exposure to fire risk from outside, and on interior partitions between engine or boiler-room and switchboard or office.

J. T. Whittlesey.

I think it advisable to use metal window-frames with wired glass in power-plant construction where there are adjacent buildings of wood. In case of fire, these windows would be a great protection.

F. C. Sargent.

We are using it almost entirely in all our power plants and substation buildings within city limits.

H. B. Gunnison.

All skylights in power-houses should be made of wire-glass. In case of breakage the glass will not then fall to the floor below. Metal window-frames obviate all fire risk that would be occasioned by the use of wood for such purposes, therefore all large power-houses and substations should be thus protected.

Geo. Ross Green.

A 8. What is the best size of crushed stone to use in 12-inch concrete tunnel-walls supporting roof 12 inches thick with 5-foot span reinforced with expanded metal 2 inches from bottom of roofing, the whole structure designed to stand 4000 pounds pressure per square foot? What proportions should be used for best construction for the size of stone chosen?

One-inch broken stone. Mixture 1-2-4.

Geo. Ross Green.

A 9. When installing a gate in salt water, covered and uncovered with the tides, what metal should be used for the guides, and so forth?

Bronze, by all means.

Clemens Herschel.

A 10. What is the probable life of a 10-inch I-beam exposed on one side to salt water?

Clean salt water is better than salt water contaminated with sewage. If clean, say 20 to 25 years, as a matter of writer's judgment.

Clemens Herschel.

B—WATER-WHEELS, WATER-POWER, ETC.

B 1. As a general proposition, is a low-head water-power installation a good investment for driving electric generators, as compared with a steam installation?

As a general proposition the water-power installation is preferable in every respect.

The Union Elec. Co.

Yes, if conditions are favorable, such as reasonably steady flow without extremes of high or low water.

P. H. Korst.

Where steam coal costs more than $3.00 per ton, where the flow of river or stream is reasonably uniform throughout the twelve months and where the first cost of development does not exceed $75 to $100 per horse-power—yes.

Edward Peterson.

Any head of more than eight feet where continuous power required will average more than 300 horse-power and the supply of water is sufficient to take care of the load, can be operated much cheaper than a steam plant of same size. The larger the load and water-power, the greater the economy as compared with steam.

Merrill Ry. and Ltg. Co.

A low-head water-power installation is a good investment if sufficient water is available the year around. If a steam relay has to be added it will pay in most cases, particularly for the smaller installation, to put in an economical steam plant and leave the water-power alone.

H. C. Stoddard.

As a general proposition, any water-power installation is a good investment as compared with a steam installation.

B. E. Morrow.

The value of undeveloped variable water-power is usually nothing if its variation is great, unless it is supplemented by a steam plant. It is of value then only when the cost per horse-power for the double plant is less than the cost of steam power under the same conditions.

The value of a developed water-power is as follows: If the power can be run cheaper than steam, the value is that of the power plus the cost of plant less depreciation. If it can not be run as cheaply as steam, considering its cost, and so forth, the value of the power is nothing, but the value of the plant is what would be paid for it new, which would bring the total cost of running down to the cost of steam power less depreciation.

S. C. Foster.

The main difficulties in utilizing a low-head water-power for driving electric generators are twofold: (1) low-head turbines and wheel-pits, and power-house construction generally, occupy so much space that they become inordinately expensive in comparison with either higher-head propositions or with steam plants; (2) low-head turbines are of slow speed, which is fatal unless a belt drive is introduced and direct connection between turbine shaft and dynamo shaft is sacrificed, which no one wants to have done. This is the answer to the "general proposition" up to date.

But now comes an invention, in the form of a simple apparatus without moving parts, which will add some 25-foot fall to any other fall by the expenditure on that other fall of an amount of water approximately equal to the discharge of the low-fall turbine. In other words, this "fall-increaser" will approximately double the fall acting on the turbine, by using twice the water; thus calling for a smaller turbine, and a smaller wheel-pit and plant generally, and also producing a greater speed; also calling for only about half the number of turbines otherwise required, but each turbine of double the otherwise-designated power. Or the apparatus may be used merely to annul the effects of back-water in floods, without changing the arrangement made for use in ordinary or in low-water periods.

It is believed that this will render water-power available on low falls (5 to 25-foot), which, either on account of lowness of fall or of much back-water, it has hitherto been impractical to develop and use, especially for driving electric generators.

A patent has been applied for on the above in the United States and Canada.

Clemens Herschel.

B 2. Can any one give reasonably accurate figures on the cost of maintaining a low-head water-power installation of, say, 8 to 10-foot head?

If original installation is first class it can be maintained for $1.00 per horse-power per year.

The Union Elec. Co.

This would depend on the method of construction. If the dam, flume and wheel-pits are of the best concrete, the depreciation should not exceed three per cent and the maintenance less. With a timber dam and wooden flume, these figures would be more than doubled.

P. H. Korst.

It depends on the class of installation and the conditions of the stream. A rock-ballasted timber dam will last fifteen to twenty years. A water-wheel of good design should last about the same length of time, unless the water is very gritty or wheel becomes broken through accident. Wooden rack and head-gates will last ten to twelve years and a wooden flume about the same length of time. With a stone or concrete dam, iron racks, stone or concrete power-house and flumes, five to six per cent on first cost should cover maintenance and depreciation.

Edward Peterson.

Ordinarily, from $1.00 to $3.00 per horse-power. This does not include interest on investment. The larger the power, the less per horse-power will be the expense of maintenance.

Merrill Ry. and Ltg. Co.

Such costs would vary with the locality. Generally speaking, an 8 to 10-foot head is not applicable to driving electric generators except by belting up for speed, and then would be likely to cost some $250 per horse-power delivered to the dynamo, including power-house and contained machinery.

Clemens Herschel.

B 3. What is a fair depreciation allowable on a low-head water-power installation of, say, 8 to 10-foot head?

About three per cent.

The Union Elec. Co.

See answer to B 2.

P. H. Korst.
Edward Peterson.

Very little for the water connections and house; say 10 per cent for the turbines; electric machinery as elsewhere.

Clemens Herschel.

B 4. What is correct average cost per horse-power per year of repairs to water-wheels, flumes, tail-races, and shafting to driving gear, of water-power installations of low head, say 8 to 10 feet?

See answer to B 2.

Edward Peterson.
Merrill Ry. and Ltg. Co.

See answer to B 3

Clemens Herschel.

B 5. Suggest scheme for the prevention of anchor ice common in the rivers and streams of this section of the country (Michigan).

Arrange booms or rafts so that river will freeze over. After it is frozen over there will not be any trouble from anchor ice.

Edward Peterson.

I know of no scheme to prevent formation of anchor ice, but its presence in a flume can be made practically harmless to successful operation of a turbine, provided there is a swift passage of water through flume. In this plant we use a long sloping grate or "grizzly" the width of the flume, constructed of flat iron bars on edge, spaced about an inch and a half apart, ending near to the water level with a horizontal platform of same construction. The rush of water from head-gate breaks the sand and gravel and slush away from the piece of cake ice to which it has anchored, when the mass strikes the grates; the former passing on through the wheel, disintegrated, and the cake ice sliding up on the platform of the grate, from which to remove it is only a question of labor.

W. P. Eyre.

No such prevention has been discovered anywhere, so far as the writer knows. Running spring water through sprinkler pipes onto the rack bars is said to be good. Letting the pond or head canal freeze over and stay covered with ice is a sure cure, and there would then remain only three or four days of trouble each winter. During these three or four days, to shut down the water plant and run by steam or buy current, would probably be cheapest, where it can be done.

Clemens Herschel.

B 6. What shall we do to prevent ice forming on inside of penstock during cold day when plant is idle, then thawing on a warm day, sloughing off and clogging the wheels?

Protect penstock so that it will not freeze.

Edward Peterson.

Cover the penstock. Bury it in the ground if you can.

Clemens Herschel.

A large and deep pond for intake will largely prevent troubles from ice in penstock. It will be noticed that there will be little trouble from needle ice after the pond freezes over for the first time in the fall.

H. C. Stoddard.

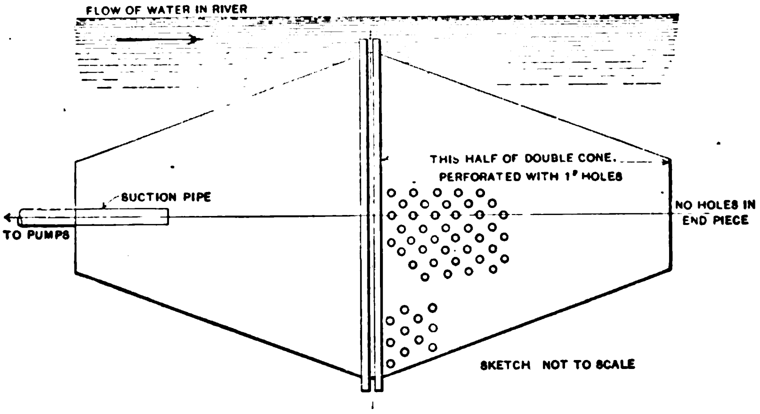
C—FEED-WATER, HEATERS AND PUMPS

C 1. In taking water from river for boiler-feed pumps, is there any standard method of building the suction inlet so as to obtain clear water, free from sand, leaves, and so forth?

The best method of taking water from a river is to enclose the end of the intake pipe in a box, the opening in the box to be provided with two screens and a gate; the screens and gate to be raised and lowered with a block-and-fall hung or counterbalanced from a gallows. This will allow the ready cleaning of the screens, one at a time. The intake pipe should be laid below mean low tide and if desirable led into a settling well and the feed-water taken from there. By closing the gate the box and settling well can be pumped dry and thoroughly cleaned from time to time.

John McFeeley.

Attached sketch shows an intake we constructed in the Monongahela River, near Pittsburgh, Pa., where we were bothered by a very large amount of leaves, driftwood, sand, and so forth.



Plan of Intake in River

Ludwig Kemper.

We do not know of any standard method of building suction inlets, but we get very good results from duplicate set of strainers, so arranged that one may be shut off and the strainer taken out and cleaned while the other is working. We use this arrangement for both boiler-feed and injector condensers.

Bennington Electric Co.

Build a screen house with inlet of ample size in order to reduce velocity of water to avoid drawing in leaves. Protect inlet by trash-rack made up of 0.25-inch by 1.5-inch bars placed vertically. Inside of trash-rack place three screens with mesh varying from 0.75-inch to 0.375-inch, and made up of 0.125-inch to 0.1875-inch wire. Mount screens in a frame in sliding guides with provision for removing for cleaning. If water contains much sand it might be advisable to divide screen house into two compartments of large capacity to form settling chambers, either of which may be cleaned, with separate inlets and outlets. A vertical baffle extending above top of water causing water to be deflected downward would assist in separating sand. Discharge water from condenser against trash-racks, or pipe steam into racks for thawing out in winter.

B. J. Denman.

I have succeeded in overcoming the difficulty by having water go into a settling basin before going into the suction pipe. This allows sand and everything to be deposited before getting to the pipe.

Walter Flint.

Use a galvanized-iron or brass-wire basket, or perforated-metal screen, on the outer end of the suction inlet.

Clemens Herschel.

Inlet must be sufficiently large to enable the velocity of entering water to be kept down. Screens so arranged as to be interchangeable—one going down as the other comes up for cleaning—are often used.

Geo. Ross Green.

C 2. Boiler feed-water is impregnated with tar from a near-by water-gas plant. What effect, in time, will the tar have on the feed-pipe, pump, valves, boilers and engine cylinders? What is the best method of extracting the tar from the water?

We have not had much experience with water impregnated with gas-tar. Our inspectors can not recall a case. Such water is not often used. The tar, unless in an amount that would condemn the water at once, could hardly do harm to feed-pipe or valves and would not be likely to reach the engine, but a very little might cause serious bagging or burning in a boiler. Tar can not readily be extracted from water. The most obvious way to get out most of it would be to have a well close to stream and get water by infiltration, taking it below surface and if practicable have a surface overflow, but waters containing gas-tar will have other substances in solution that are injurious to a boiler, and such water had better not be used.

Hartford Steam Boiler Inspection and Insurance Co.,
George H. Seyms.

The effect of water-gas tar upon the feed-pipe, pump, valves, boilers, and so forth, will in time undoubtedly be some corrosion of the metal parts with which the water itself comes into contact previous to entering the boilers, and if present in the water in material quantity, more or less gumming of the valve-seats, and possible accumulation of said tar upon the inner surfaces of the feed-line, and so forth. After reaching the boiler more or less corrosion, especially in the steam space, will undoubtedly result, and in high-pressure plants a carrying-over of a sufficient amount of volatile substances with the steam will, by becoming incorporated with the cylinder lubricants, very much impair the lubrication. As to the extraction or separation of the tar from the feed-water, no doubt a considerable portion of it could be removed by filtration, as it would not be soluble in the water itself. However, very much of same would be soluble, and could not be so removed. The addition to the water before filtering of, say, one-half to one grain of sulphate of alumina per United States gallon, would undoubtedly bring about a coagulation of that portion of the tar in solution, and in such coagulated condition it would be removed by filtration along with the insoluble portion.

W. A. Converse.

C 3. Explain action of boiler compound when placed in an open heater. How should it be fed into the heater?

As there are many boiler compounds, their action would be different in a heater. In general, however, most compounds depend for their effect on soda-ash or a mixture of that with some kind of tannin. Soda-ash changes the lime sulphate of the water to lime carbonate and with aid of the heat renders the lime and magnesia carbonates more flaky or granular and easier to wash and clean out. Substances containing tannin serve to make softer sludge of the deposit. A compound can be introduced into a heater in any convenient way, only it should first be in solution, and care should be taken that some amount of it is always in the heater; for that reason it should be put in at least daily.

Hartford Steam Boiler Inspection and Insurance Co.,
George H. Seyms.

The action of any boiler compound when placed or fed in an open heater would depend entirely upon the composition of the compound itself, together with the composition of the solid matter contained in the water with which same was being used. With a water carrying quantities of sulphate of lime, sulphate of magnesia, chloride of lime or chloride of magnesia, and a compound carrying quantities of soda-ash, caustic soda or tri-sodium phosphate, the result would be a reaction between the soda salts and said chloride or sulphates, causing a partial precipitation of the lime and magnesia salts, leaving in solution in the water, as a by-product, soluble soda salts, namely, chloride or sulphate, depending upon whether the reaction took place between the chlorides or sulphates of lime and magnesia previously referred to. In practice this precipitation is not a preventive of scale formation in the boiler proper, as a considerable amount of the light precipitated matter is carried with the water from the heater to the boiler, and this suspended matter, together with a portion of the lime and magnesia salts not precipitated in the heater, which are thrown down after reaching the boiler, due to concentration, combine in the formation of more or less scale or incrustation; the quantity being dependent upon, first, the kind and quantity of incrusting solids contained in the water; second, the temperature and size of the heater itself. We do not believe that in most cases in practice it is advisable to feed compounds into or through open heaters. We believe it better to get the best out of the heater possible without the use of any preparation, then, by the use of the proper preparation directly in the boilers themselves, prevent and eradicate further trouble in the form of scale.

W. A. Converse.

Better feed compound into outlet pipe from heater. Put compound into tank, so placed that the compound will flow in by gravity. Connect tank and outlet pipe with small pipe having a valve for regulating the flow of compound; or feed compound into the pump discharge with a small pump or injector, as many compounds are injurious to pump packings.

B. E. Buttles.

C 4. Soda-ash does the same work in our boiler as prepared compound containing soda-ash and common salt. Will the ash, alone, have any injurious effect, and if not, what is the salt for?

The effect of common salt and of several others of the substances usually found in water is to increase the solubility of the lime sulphate and partly prevent its depositing as a hard scale. As soda-ash, used in proper amount and put into boiler daily, decomposes the lime sulphate, the use of salt with it is unnecessary. Pure salt does no injury to a boiler. Saline water, as, for instance, a little infiltration of sea water into ordinary well water, is very injurious and corrosive. Soda-ash has been found by long experience to be non-injurious.

Hartford Steam Boiler Inspection and Insurance Co.,
George H. Seyms.

Soda-ash alone is not injurious to a boiler, since it has no affinity for iron. The salt is supposed to precipitate some scale-forming ingredient which is not precipitated by the soda-ash.

B. E. Morrow.

In considering the first part of this question—pertaining to the effect of the use of soda-ash alone—it is a fact that in most cases where this substance is used as a preventive of scale formation, or for the removal of old incrustation, more or less trouble is experienced in the form of corrosion and pitting; in cases where the boilers are being crowded, overworked, or submitted to very uneven load at times, foaming and possibly priming; and with waters in which the soda salts naturally existing are proportionately high as compared with the incrusting solids, oozing out at and causing leaky joints, destruction of gaskets, and so forth. The amount and intensity of the above deleterious effects that would be obtained from the use of this substance for the purpose named are entirely dependent upon the nature, quantity and kind of solid matter contained in the water in conjunction with which same is used. This being the case—and as its use is not being considered with a certain specific water of which the composition and quantity of solid matter present are known—it is impossible to go much into detail as to just what the results would be in any particular case. Referring to the latter part of the question—as to the purpose of the addition of salt—would say that is also objectionable, especially as being the cause of corrosion and pitting. The objects of the use of the substance are, we believe—first, to reduce cost of the preparation; second, because sulphate of lime (gypsum) is soluble in solutions of sodium chloride (salt), provided the solution itself is saturated (not materially so, however, in weaker solutions). This being the case, it would be necessary that the water in the boiler be saturated with salt in order to add any efficiency to the preparation proper along the lines referred to, and if said solution became saturated the corrosive action that would arise would be very objectionable.

W. A. Converse.

C 5. In good practice, what percentage of the total power generated is required for operating—(a) Circulating pumps? (b) Air-pumps? (c) Oil-feed pumps? (d) Exciters? (e) Coal-handling apparatus?

I know of no definite data that are accurate in detail. The following was stated to be the results attained in one of the largest power plants in the country:

	Per Cent of Steam Generated
Steam consumption of main engines	95.80
" " " exciters	1.09
" " " auxiliaries	3.10
	99.99

In this plant the coal-handling machinery was operated by electric motors.

A. D. Williams, Jr.

In a large station, power used for circulating pumps, steam-driven, allowing for return of exhaust steam to heaters, should not greatly exceed 1.5 to 2 per cent. The air-pump, 0.5 per cent. Exciter, motor-driven, 1.5 per cent.

Geo. Ross Green.

C 6. Does gain in economy by use of economizers compensate for added complexity and cost of repairs?

Only in exceptional cases of high cost of fuel and high load-factor.

J. T. Whittlesey.

Engineers are not agreed on this question. In extensions to some modern power stations that contain economizers, they are not being installed, although provision is made for installing them if desired.

B. J. Denman.

C 7. What has been the experience as to cost of maintenance of economizers per boiler-horse-power in good-sized installations?

We have had an economizer equipment in use on a 1200-hp boiler installation for the past six years. Thus far the cost of maintenance has been merely nominal. We attribute this to the fact that the water supply into the economizer is passed through a preliminary heater into which small auxiliaries exhaust. The water enters the economizer at about 140 degrees.

Editor.

C 8. Are recording thermometers sufficiently accurate to justify their use in recording temperature of boiler feed-water when thermometer is placed 100 feet from and 15 feet above point of connection to feed-pipe?

A Bristol recording thermometer can easily meet the conditions imposed by this question. It is preferable, however, that the connecting capillary tube between the bulb and the recording portion be kept at a cooler temperature at all times than the bulb. In practice, this condition can undoubtedly be met without effort.

H. P. Dennis.

As manufacturers of recording thermometers, would say that our instruments are entirely independent of all changes in the temperature between the recording portion of the instrument and the bulb of same. A slight error may be shown when the recording portion is placed 15 feet above the point of connection of the feed-pipe, due to the column of expansible liquid in the small capillary tube. This holds good only when thermometer has been tested with the bulb on the same level as the recorder. When this company knows the difference in elevation between the bulb and the recorder, allowance will be made for such elevation when the instrument is calibrated.

The Bristol Company.

C 9. Give reference to best literature on construction and operation of centrifugal pumps.

D—FUEL

D 1. Has anything been done in this country, outside of municipal plants, in the use of garbage as fuel?

D 2. What is the most economical method of generating gas for power plants?

The most economical method of generating gas for a large power plant is the Mond process; for a small power plant, the suction producer installation; for intermediate powers, pressure producer installations.

R. D. Wood & Co.

D 3. State value of oil as compared with wood and coal for fuel purposes.

By weight, oil 100, wood 11, and coal 63.

B. J. Denman.

D 4. What practical results in economy have been obtained by the use of a mixture of bituminous and No. 3 buckwheat coal?

D 5. The Western Electric Company, in its descriptive catalogue on Hawthorne Works, page 7, makes the following statement: "Carefully executed tests in Europe show that nearly 30 per cent of the heating value of coal is lost in six weeks when exposed to the air. By keeping the bins flooded the company expects to reduce the losses of the coal to approximately two per cent of its heating value after six months to a year storage." Are these statements verified in the experience of the members of this association?

About 1902, the Western Electric Company, at Chicago, Ill., after carefully investigating the question of uncertainty of coal supply, due to strikes and other conditions beyond its control, decided to provide for storage of a considerable amount of this fuel. As experience with coal bunkers at the Clinton street plant showed very clearly that the Illinois coals, which the Western Electric Company makes use of, when stored in ordinary bins exposed to the air suffered very materially from spontaneous combustion, it was decided to dig a hole in the ground at the Polk street plant and store a large quantity of coal under water. This was carried out with very satisfactory results, inasmuch as no trouble has ever been experienced there from spontaneous combustion. When it was decided to provide for a large storage of coal at the new plant at Hawthorne, Ill., it was thought advisable to follow the same scheme, and a storage pit, built of concrete, divided up into three sections and covering a ground area of about 310 feet by 114 feet, was provided. It is arranged for filling with water so as to entirely cover all the coal that may be placed in it. As constructed, each section is approximately 15 feet in depth, and the whole pit has a capacity of approximately 10,000 tons, which reserve is kept exclusively for emergencies. Three railroad tracks are carried on concrete piers and arches running the entire length of the pit, thus dividing each of the three sections of the latter into four equal divisions. There are also two railroad tracks, one on each side outside the pit, running its entire length, so that coal cars may be emptied into or loaded from the storage pits while on any one of five railroad tracks. A locomotive crane, fitted with a grab-bucket, is provided for taking the coal out of the storage pit and loading it into the coal cars. No provision is made for drying the coal before use, as it is believed that the handling of the coal will result in its being dry enough for all practical purposes by the time it reaches the boilers. In the *Engineer* (England) for September 4, 1903, in the "Leading News" column, commenting on a report that Lord Charles Beresford had stated that possibly 50 per cent of the heating value of coal is lost when the coal is stored for a considerable length of time in piles exposed to the open air, the statement is made that the loss in calorific value will probably be found in practice to be between 10 and 15 per cent, with a possible maximum of 20 per cent. In the same paper for September 18, 1903, Lieutenant Carlyon Bellairs, R. N. (British), in a communication to the editor states that from second-hand evidence he believes that the coal stored at Hong

Kong loses from 20 to 40 per cent of its calorific value, with a probable average of from 20 to 25 per cent. Mr. John Macaulay, general manager of the Alexandra Docks and Railway of Newport, Monmouthshire, Wales, contributed an article to the *Engineer* (England) under date of October 30, 1903, in which he stated that as a result of his experiments and observations he believed that coal submerged to a considerable depth in water so that the coal would be stored under pressure would not lose more than three per cent of its calorific value after being stored for twelve months, whereas if the same coal were stored in the open air in England, at least 12 per cent would be lost, and in a hotter climate from 18 to 24 per cent. These opinions apparently all refer to bituminous coals, running probably 30 to 35 per cent volatile combustible matter, similar to the Illinois coals that the Western Electric Company makes use of. The Western Electric Company has never made any careful tests to verify the opinions expressed above, but there is very little doubt that said opinions are amply borne out by practical experience.

Mr. Macaulay, referred to above, found that coal submerged in salt water showed an apparent increase in heating value, which may or may not have been caused by the salt in the water, but the Western Electric Company has not thought it worth while to go to the expense of throwing salt into its storage pits with the idea of enriching the coal.

W. R. Patterson.
O. C. Spurling.

Extracts from article on sub-aqueous storage of steam coal, by Mr. John Macaulay, in the *Engineer* (England), October 30, 1903: "I think it can be broadly and temperately stated that coal submerged for a year would not lose more than three per cent of calorific value, whereas stored in this country (England) it would lose four times as much, and in hotter climates six to eight times as much. . . .

"To sum up . . .:

"(1) Storage of steam coal under water appears to offer economic and other advantages over storage with exposure to air, whether wholly in the open or under sheds.

"(2) The saving in calorific value and gain in working power is probably due to the retention more completely by the coal of its original chemical and physical properties lost in storage in air by (a) dissipation of natural volatile constituents, (b) oxidation, and (c) the weathering effect of sun, wind, rain and frost.

"(3) There may possibly be some increase in the working power of submerged coal due to its permeation by the salt of the sea water."

Editor.

We used 2600 tons of Ohio No. 6 and Pennsylvania gas, mine-run coal last summer that had been stored four years on a lot 150 feet square. The coal had lost about 10 per cent in weight, but much of this was probably stolen. Our coal per kilowatt-hour was as low as with good slack, and if there was any depreciation in full value it did not exceed five per cent.

W. C. Anderson.

We store about 600 tons of bituminous coal during the winter and can not find that the heating value of the coal is reduced at all.

Ludwig Kemper.

E—BOILERS AND MECHANICAL STOKERS

E 1. In the case of two return tubular boilers of about 100 horse-power each, one good for 125 pounds, the other for 85 pounds, both well set (if any difference the 125-pound boiler the better), same coal and same fireman, only one boiler used at a time, the 125-pound boiler takes about one pound more of coal per kilowatt-hour than the 85-pound boiler. What is the reason?

The fact that 85 pounds of steam pressure was used in one case and 125 in another, would result in the contents of one boiler being at a lower temperature than the other; thus the one carrying 85 pounds pressure would have an advantage, because, owing to the lower temperature of the cooling medium, gas temperature could fall a greater amount than possible with the 125 pounds steam pressure, or, in other words, more heat could be abstracted therefrom. It is not probable, however, that such a large difference as the evaporation of one pound of water per pound of coal resulted from this cause, although the inquiry does not state the number of pounds of water that were evaporated in the two cases.

A. Bement.

E 2. What is the cheapest method of holding steam on boilers as reserve against high-tension transmission breakdowns? Banked fires take too much coal, make dirty fires and allow steam to drop. Small auxiliary boiler piped to the main boilers has been suggested, also temporary narrowing-up of fire-box of boilers so as to allow of small live fire being kept.

Fuel oil or gas seems to offer the best solution.

J. T. Whittlesey.

E 3. Has any one secured any abatement of the smoke nuisance? If so, how much, and how was it accomplished?

Smoke may be almost entirely eliminated by the use of chain-grate stokers with non-coking coal and underfeed stokers with coking coal.

B. J. Denman.

Very important results have been secured in the abatement of smoke by the construction of proper furnaces and by having boilers so designed as to make it possible to install a properly-constructed furnace.

Those interested will find much valuable matter in the December issue of the "Journal" of the Western Society of Engineers, which may be obtained from the secretary of the society, Mr. J. H. Warder, Monadnock Block, Chicago, Ill. In addition to this, the *Peabody Coal Atlas*, recently issued by the Peabody Coal Company, 125 Monroe street, Chicago, contains the most extensive set of illustrations thus far published, showing desirable types of furnace construction.

It is not only possible, by use of properly-selected and arranged stokers, to produce an apparatus that is smokeproof, but it appears that it may be possible to make hand-fired apparatus smokeproof. At all events, furnace construction may be adopted which will at least insure that any stoker or hand fire may be manipulated so that no smoke will be made, and this can be accomplished with very little labor and effort on the part of the operator or fireman.

A. Bement.

Smoke prevention by the Ganz apparatus has been receiving some attention lately in European technical papers. The apparatus consists of a steam jet with air supply above the fire and an adjustable smoke regulator or damper. The steam jet is set in action by the opening of the furnace door, and the damper is at the same time opened to its fullest extent. After a stated time, which can be varied at will, the steam jet is put out of action, and the damper returns to the normal position, both movements being automatic. The frequency and length of the periods during which the steam jet is worked, and the final position of the damper, must be suited to the size and design of the furnace and to the character of the fuel burned. Tests with this apparatus were carried out in Vienna by M. Tejessy with three Tischbein boilers, using coal having a heating value of 6200 kg-calories. When the Ganz apparatus was not in use the efficiency of the boilers during a seven-hour trial was found to be 74.4 per cent, while this was increased to 81.80 per cent by use of the smoke-prevention apparatus, and the suppression of smoke was practically complete. This gain in efficiency was equal to a saving in coal of 9.3 per cent. The steam jet was in operation only one and one-half minutes at intervals of six minutes, and by special trials it was found that it consumed only one per cent of the steam generated.—[From *Engineering Record,* March 23. 1907.—ED.]

During the past year we have installed Jones stokers under our seven tubular boilers and have abated the smoke completely, except when cleaning fires, and then have very little smoke compared with our old hand-fired system.

H. H. Rice.

We have installed the Murphy furnace under our boilers, and have overcome the smoke nuisance entirely.

United Eectric Light Co.

The Murphy automatic furnace is a smokeless furnace from any practical standpoint. When a Murphy furnace shows any smoke whatever at the stack there is always a cause, and that is an abnormal condition somewhere; but this condition is exceedingly rare, and I believe it is fair to state that the Murphy apparatus is perfectly smokeless at all times and under all conditions.

To state that this or that furnace is smokeless, as witnessed by the appearance of the stack, does not, in my opinion, answer the question in a manner to convey to you whether you could accomplish the same smokeless results. I am familiar with stokers and furnaces that are running for weeks without producing smoke, but the conditions under which they are running are such that even a flat grate properly handled would be quite as smokeless. These, in a sense, are *minus* conditions, not being such as develop the full actinic value of the plant, and, in my judgment, should not be taken seriously.

When one states that his particular furnace is smokeless he should also state how much coal is burning to a square foot of grate as well as the particular kind of bituminous coal he is burning. Bituminous coal with 20 per cent volatile matter and coal with 35 per cent volatile matter are two vastly different propositions, and while a Murphy furnace will be found smokeless with either of these analyses it arises from several philosophical reasons: First—The period allowed the coal to distill its gases within the furnace before being forced upon the grates. In a gas plant, for instance, what folly it would be to arbitrarily fix a time for filling and drawing a retort! The time element for distilling the gases in a boiler furnace is as essential as in a gas retort. Second—The proper and intimate admission of oxygen to meet this distillation within the furnace. Without these conditions, smoke will be produced and a certain loss will result. By "proper and intimate," I mean, first, admitting oxygen at a high temperature and in sufficiently large but controllable quantities to meet all varying conditions. Second, admitting the oxygen at the exact locality at which the distillation of the coal is taking place within the furnace—and particularly in small jets—thus combining instantly with the hydrocarbons being so rapidly thrown off. Bringing the coal, in both its solid and gaseous elements, into intimate mixture with oxygen to ignite the compounds is all that human means can accomplish, nature only, through her own processes, effecting the rest. The distillation of gas when coal is first forced into the furnace takes place on or near the surface of the fire; the gas naturally burns above the surface and the oxygen necessary for its combustion must be admitted, therefore, above the surface. The necessity is this: Whatever amount of air passes through the grate will chemically combine with the solid part of the coal—the coke. The product of this combustion is carbonic oxide, and, although at a great heat, the oxygen that has entered into these compounds can serve no further combustible purpose.

The question frequently presents itself and will be found exemplified in certain stoking apparatus—"Why not provide at once for the admission through the grates, or tuyères, of sufficient air both for the coke and for the gas?" This is an impossibility, for whatever the quantity of air admitted through the grate or tuyères, it will expend itself on the coke only—at least until holes are burned through the fire bed, when the control of the air is at once lost and great waste of fuel ensues, with possible injury to the boiler by a blowpipe action.

Air in bulk (so to speak) mixes only superficially with gas and, by abstracting heat, cools the furnace; therefore, the arrangement of air-ports in the Murphy furnace. This is philosophical, and meets the required conditions perfectly by intercepting the distillation at the start; otherwise, the combination, which is at best gradual, will not be completed in season, as what remains uncombined on reaching the tubes or shell of the boiler is lost. Hence, we have reason to expect as nearly ideal conditions in the Murphy furnace as is possible, for it is constructed to meet these requirements by bringing the coal into the furnace on the sides, and I do not know of any mechanical apparatus where the coal is fed through the front, in which these smokeless conditions are obtained, nor do I believe it possible to obtain them and work your boiler up to its normal capacity, and away beyond, with a 20-per cent volatile coal, much less with a 35-per cent volatile coal. The whole grate surface of a Murphy furnace being covered with an arch permits a more perfect combustion of the gases and coke, and results also in reaching peak-load conditions that are not obtainable with any other construction.

Orosco C. Woolson.

A certain boiler plant has not, since it was first installed, emitted any smoke from the stacks. This is not "practically" true, but literally true; not even the brown gas that is mentioned in smoke ordinances being present. For a period of practically half an hour when a new fire is being started a light-brown smoke appears. The apparatus used to accomplish this result consists of a Babcock and Wilcox chain grate in an external furnace connected to vertical water-tube Cahall boilers. The arrangement of this grate and furnace is a little different from the ordinary installation. Some quite radical changes were made in the construction of the grates when they were installed. The links of the chain composing this grate are so constructed that they have only 20 per cent air space; the carrying rolls to the grate are as close together as they can be placed. The usual sprocket for carrying the chain at the back end is replaced by a drum. These were the essential changes in the chain mechanism. The setting is peculiar in regard to the height of the fire-arch, the arch being six or seven feet above the grate at the back and four feet at the front. The bridge walls, or rather the projection of the floor of the arch at the back of the grate, was extended so that it overhangs the flat part of the grate a foot or more. The changes in the grate enable the fire to be maintained at a high temperature, carrying a comparatively thin bed without damage to the grate bars. The drum at the back prevents jamming and facilitates the displacement and removal of the clinkers. The high fire-arch provides ample space for complete combustion so that the gases are all completely oxidized before coming in contact with the cold surfaces of the boilers. With this installation of grate and furnace any kind of coal can be burned without producing any smoke whatever, the only requirements being that the coal be fine enough to pass under the feeding grate without choking and that it be as near a non-coking composition as possible. This latter condition, however, is not difficult to fulfil, as most of the soft coals can be handled in this furnace. There is one objection to this arrangement of furnace, and that is the space occupied. As stated, the fire-arch being very high, and the grate itself, with the necessary depth of ash-pit, require considerable space in a vertical direction. The repairs on this grate and furnace are comparatively light; the only part that suffers materially is the extended bridge wall.

The wear on this, however, is not excessive, and taken altogether the maintenance of this furnace is very light. The use of this arrangement of furnace under all steam boilers would reduce the smoke nuisance very materially.

W. Cooper.

E 4. Has any one made any special changes in furnace construction for the purpose of securing smokeless or more efficient combustion? If so, what were the changes and what the results obtained?

See answer to E 3.

W. Cooper.

E 5. Has any one had experience with boilers baffled in a manner causing the combustion gases to flow in contact with the heating surface in any way differing from that of boilers as usually installed by manufacturers? If so, how was the baffling arranged and with what results?

In the case of certain Heine boilers, 17 tubes high, an arrangement of baffles causing the gases to flow three times the length of the boiler on a horizontal line along the tube surface resulted in about 20 per cent more steam being made per pound of coal than when the gases flowed only the length of the boiler once. With a double flow of the gases by means of one inserted baffle, the amount of steam made per pound of coal was increased 10 per cent. In each of the cases of baffling the capacity was about 3.5 per cent higher than obtained with the single flow. With the triple flow, however, the draft at the fire was reduced to about one-third, while with the double flow it was changed but a slight amount. Any extensive scheme of baffling, however, sets up a resistance to the flow of the gases, requiring additional draft facilities, but proper baffling entails very much greater capacities being obtained from boilers than is possible with old styles of baffling without reducing efficiency.

A. Bement.

See answer to E 3.

W. Cooper.

E 6. Is the furnace of the gas retort, or any modification of this furnace, applied to steam boilers? If so, with what results?

This inquiry appears to refer to a gas producer used in series with a steam boiler. Probably the most feasible example of such application is illustrated by that character of boiler and furnace construction described in a paper presented before the annual meeting of the American Society of Mechanical Engineers in 1906, entitled, *Improved Boiler and Setting,* wherein a chain-grate stoker is located in a long tile-roof furnace, so that the volatile gases are necessarily burned before they reach the boiler, insuring completeness of combustion and smokelessness, together with an automatic discharge of the ashes, which the gas producer does not possess. A gas producer may be applied to a boiler and the gas be burned under it, air being admitted for that purpose, and thereby complete combustion can be very easily obtained; but the complication of the producer is considerable and its manipulation is a serious matter; therefore, starting with the idea of such application, its simplification and improvement would lead ultimately to the character of apparatus above referred to.

A. Bement.

F—FORCED DRAFT, BLOWERS, STACKS

F 1. What experience have members had with the McLean balanced draft system, of the Engineers' Company, of New York?

Experience of the Hudson River Electric Power Company with the McLean balanced-draft system of the Engineer Company, of New York.

This plant was built to be used as an auxiliary to a water-power development and was equipped with an induced-draft system in order to get steam as quickly as possible when it becomes necessary to operate the plant.

A proposition was received from the Engineer Company to effect a saving of 20 per cent in the cost of fuel by using their balanced-draft system instead of the induced-draft system. They also guaranteed an increased capacity for the boilers. A series of nine tests was made with the induced draft, using various kinds and mixtures of coal; and a second series of thirteen tests was made with the balanced draft, using various kinds and mixtures of coal.

As a result of these tests it was found that the balanced-draft system effected a saving in the cost of coal of over 20 per cent and that the capacity of the boilers was materially increased.

The analysis of flue gases showed a maximum with the induced-draft system of 5.9 per cent of CO_2 and a maximum with the balanced-draft system of 16 per cent of CO_2.

The most economical mixture of coal has been 84 per cent of anthracite No. 2 and No. 3 buckwheat and 16 per cent of bituminous slack. With the induced-draft system the smoke was so dense that the city authorities insisted upon the company using apparatus that would not cause a violation of the smoke ordinance. Since the installation of the balanced-draft system there has been no complaint from the city, as there is practically no smoke.

In the following statement of cost of operation the steam required to operate the engines for both the induced and the balanced-draft systems is not considered. It will require somewhat less steam to operate the balanced-draft engines, but the exact saving has not been determined.

COST OF OPERATION, YEAR ENDING MARCH 20, 1907

INTEREST AT 5 PER CENT ON BALANCED DRAFT		
System as installed, costing $26,000.00		$1.300.00
Brought forward		$1,300.00
SUPPLIES		
69 gallons of engine oil at 25 cents	$17.25	
274 gallons cylinder oil at 50 cents	137.00	
		154.25
REPAIRS		
Labor on repairs	$30.00	
Damper regulator and fulcrum keys	13.44	
Valve parts	10.00	
Cylinder for regulating valve, rings, springs and diaphragms	4.10	
Damper regulator	9.00	
		66.54
Labor on cleaning boilers caused by deposit back of bridge walls requiring cleaning more often than with the induced draft		270.00
Total cost of operation in excess of the induced-draft system		$1,790.79
SAVING DUE TO BALANCED DRAFT		
20 per cent saving in coal		$12,664.00
Cost of operation in excess of the induced draft		1,790.79
Net saving in the year's operation		$10,873.21

There is a further saving due to the fact that we are now carrying our load with six boilers, while formerly, with the induced-draft system, we were compelled to operate ten boilers. This has reduced our coal consumption per kilowatt-hour, as we are not compelled to burn as much coal under the boilers where the fires are banked.

C. E. Parsons.

The plant in this building consists of four 200-hp boilers, having a stack of ample size and height, but, unfortunately, at the primary construction the flue was not only restricted in area but led with several sharp turns and dips to the stack, having the effect of reducing the draft to about 0.3 inch at the back of the boilers. To overcome this difficulty a large fan was placed on the roof, drawing from the stack and discharging to the atmosphere. This did not give the necessary relief, and the boiler plant with all four boilers running was at no time adequate to the demands and we were constantly forced to use street current to help out when an extra load came upon us. Since the installation of the balanced-draft system, we have operated our plant during the heaviest periods with three boilers and now run continuously this way. This practically gives us an extra boiler, something that we had long wanted but could not in any way provide for, due to the limitations of our boiler-room. Our object in having this system installed was to obtain the relief above noted, and with this comes a considerable saving in our coal bills, which makes a satisfactory showing all around.

Robert Rose.

F 2. Are steam blowers with shaking grates found to be economical?

From records of tests which we have before us, the best performance of steam blowers in connection with shaking grates indicates that they would require about eight per cent of the steaming capacity of the boiler to operate the blower. They answer very nicely sometimes for increasing the steaming capacity of the boiler without increasing the stack, but for economical results they should not be used.

M. E. Oliphant.

We assume this question to mean, *Are steam blowers with shaking grates more economical than natural draft with station-*

ary grates? They are somewhat more economical, but any kind of air blast is conceded to be more economical than steam blowers. Better than this is a system of mechanical draft that is balanced to the point of having atmospheric pressure at the firedoor.

H. A. Pickel.

By "steam blowers" we assume that you mean a steam jet, not a steam fan, which in the trade is a fan driven by a direct-connected steam engine. Tests have shown that the steam jet requires in its operation much more steam than the fan blower, and hence is usually considered less economical, but the jet is easily and inexpensively installed. The fan blower when driven by a direct-connected steam engine takes about 1.5 per cent of the steam generated by the boilers, and if the exhaust from the fan engine can be utilized for heating, the cost of operation is very small indeed. With the steam jet 5 per cent of the steam generated is about the smallest figure, and 8 to 10 per cent is more common. There have been cases where over 20 per cent of the steam was used in the jet. Still further, steam that goes through the jet can not be utilized for any other purpose.

Carl S. Dow.

Steam blowers are seldom, if ever, economical in steam-boiler furnaces. Shaking grates are very economical when used properly and with certain coals.

B. E. Buttles.

Economy being a relative term, comparisons must be instituted:

(a) With natural draft (or induced draft).

(b) With other blowers.

The economy, when compared with *natural draft,* will depend largely upon the fuel available.

Where No. 2 buckwheat anthracite can be obtained, or where there is a supply of coke breeze to mix with coal (not to burn alone), the steam blowers and shaking grates will be found more economical than natural or induced draft. Where bituminous coal is the fuel, steam blowers and shaking grates, considered as the entire equipment contemplated, will not show any marked advantage, and not such an advantage as to warrant their adoption.

Shaking grates will not burn coal smaller than No. 2 buckwheat, bird's-eye or rice anthracite without a noticeable loss through the grate-bars, hence the utmost economy—which can only be secured with such fuel as No. 3 buckwheat, culm from banks, or coke breeze, or with refuse or slack bituminous coals—is dependent on the use of stationary grates in combination with the most economical steam blowers and the other elements going to make up a complete combustion system. Under the last-mentioned conditions, steam blowers have successfully competed with efficient natural draft on soft coal.

Comparing the economy of steam blowers with fan blowers: Fans use, as a minimum, speaking generally, 2 per cent of the boiler's output to produce draft. In practice they use 3 per cent and have been found to use over 4 per cent after a year's service.

Steam blowers of the McClave type, but not of their manufacture, have been tested *(Kent's Steam Boiler Economy,* p. 150) showing 7.4 per cent of the boiler's output to furnish steam for blowers. The fan under similar conditions used 4 per cent. Parson's 9-jet type has been found to use from 6 to 8 per cent. Parson's single-jet type, however, uses from 1.5 per cent on fairly good bituminous coal, to 3.5 per cent on No. 3 buckwheat of poor quality. It must be noted, however, that these tests of the Parson blower have only been made when used as a part of the apparatus of the Parson system, with its features of superheated steam, special grates, special bridge walls and automatic regulation.

With proper provisions made for the due operation of steam blowers they have proved to be quite as economical as fans and have the advantages of lessening or doing away with clinkers, being divided up into small units, thus minimizing the danger of breakdowns and freedom from repairs both to blowers and to grate-bars. Fans have the advantage of being free from noise, but the steam blower has been found capable of being muffled without material loss of efficiency.

G. L. Prentiss.

F 3. What is the best method to hasten steaming on auxiliary boilers?

For hastening the steaming of auxiliary boilers, there is nothing that works with greater satisfaction and economy than a properly-installed induced or forced-draft system. In some cases, where the stack capacity is ample, forced draft can be applied at a smaller initial expense than induced, but in most cases it is found that induced draft is the more satisfactory.

M. E. Oliphant.

The best method would depend upon the size and the operating conditions. For small boilers and short periods the steam jet would probably be satisfactory, for the cost of operation would not be important. For larger service and many conditions the fan blower would be better and more economical, although more expensive in first cost.

Carl S. Dow.

Use forced or induced draft.

B. E. Buttles.

The best method of handling this proposition is to have auxiliary boilers equipped with forced draft, with automatic regulation of the supply of steam to the blowers depending on the steam pressure.

G. L. Prentiss.

F 4. We have a brick stack 145 feet high, 52-inch flue, and want to increase boiler plant about 400 horse-power. Which would be cheaper: new stack or mechanical draft of some kind?

Mechanical draft.

Edward Peterson.

The chimney is capable of serving about 500 horse-power of boilers. (Kent's *Pocket Book*, p. 735, 1899 edition.) To add 400 horse-power would mean additional draft apparatus, unless the actual installation was much less than 500 horse-power. If the chimney is of capacity sufficient only for the present horse-power, the additional equipment would call for a new chimney nearly as large as the present structure. It would be more economical to install a forced-draft system for the entire plant, including the new boilers. A five-foot fan would probably be sufficiently large for the 900 horse-power, and erected with its ducts its cost would be probably one-fourth to one-third that of the new chimney.

An induced-draft apparatus would probably require a seven-foot fan, which would be a little more expensive. In general, it might be said that the mechanical draft would be most economical, although whether forced or induced would depend upon the quality of the coal burned and whether or not an economizer was used. Experience shows that all grades of bituminous coal can be burned with induced draft, but clear buckwheat can not be satisfactorily and economically burned with this system.

Carl S. Dow.

An induced-draft system would be fully 25 per cent cheaper to install than a new stack. This would include a suitable fan with direct-connected, high-grade, self-oiling steam engine and the necessary connections to the fan inlet and short stub-stack for the fan outlet.

M. E. Oliphant.

The stack in question at a consumption of four pounds of coal to the horse-power would be adequate, under natural-draft conditions, for about 525 horse-power, in practice, developed from the boilers. If you were to add 400 horse-power to this plant, you would come near doubling its capacity. To find the comparative figures as between new stack and mechanical draft two elements would have to be considered, namely: cheapness of first cost and cheapness of operation. The introduction of an induced-draft plant to assist the stack to the extent desired would lessen the efficiency of the boilers, so that the first cost, while low, would be more than offset by the increased cost of operation. Induced draft, speaking generally, is being largely discontinued on account of this very fact. It would be possible to put forced draft upon this stack and secure about 925 horse-power if economizers are not in use. If they are in use it would be possible to secure, approximately, 800 horse-power. It would be cheaper to build a supported steel stack to take care of the 400 horse-power than it would be to put in forced draft. It would be cheaper to put in forced draft than to build a brick stack for that purpose.

G. L. Prentiss.

F 5. Is there any appreciable difference in the draft of a brick stack, of a given height and area, if round or square?

In a stack, the head lost in friction is inversely proportional to the hydraulic mean depth, that is, the ratio of the area of the flue, perpendicular to the flow of the gases, to the perimeter of this area.

Let d = diameter of the round flue; s = the side of a square whose area is equal to that of the circular section.

$$\tfrac{1}{4}\,\pi\,d^2 = s^2;\; s = 0.886\,d.$$

Let N = head lost in friction in the square stack and M = head lost in round one.

$$\frac{N}{M} = \frac{4 \times 0.886\,d \times 4\,\pi\,d^2}{\pi\,d\,4\,\pi\,d^2} = 1.128.$$

$$N = 1.128\,M.$$

Professor J. W. Richards, in his *Metallurgical Calculations*, gives the head lost in friction in the average stack as 7 per cent. Assume this condition for the round chimney, then that of the square would be 7 per cent × 1.128 = 7.9 per cent. The average available head he gives as 88 per cent. For a square section this falls to 87.1 per cent, consequently the available head is about 1 per cent less for the square stack, friction alone considered.

The heat lost by the gases while in the chimney is proportional to the extent of the radiating surface. That of the square stack is again 1.128 times as large as that of the round, reducing the average temperatures correspondingly. If there were 100 degrees difference between the gas at the bottom and top of the round stack then there would be approximately 113 degrees difference in the square one. With the average temperature of the gases at 500 degrees in the square, then for the circular we should have 506.5 degrees, and the available draft would be approximately 1 per cent less for the first. These two considerations give the circular stack the advantage of about 2 per cent.

The wind pressure on the square stack would be 1.772 times greater than that on the circular.

John Cyrus Distler.

F 6. Give approximate cost, including foundation, of a steel stack, brick lined; red-brick stack, fire-brick lined; circular hollow-brick stack, and reinforced concrete stack.

		11 Feet by 175 Feet	10 Feet by 175 Feet
(a)	Steel shell	$6,300	$6,200
	Lining	3,400	3,100
		$9,700	$9,300
(b)	Steel shell and lining....	$6,900	....
	Steel shell and foundation	....	6,400
	Lining	....	1,450
			$7,850
(a)	Hollow-brick	$6,000 to $6,800	$5,900 to $6,600
	Foundation	$2,700	$1,700

In two cases under similar conditions the same contractor charged $1,000 less for a stack 6 inches larger in diameter and 50 feet higher than the more expensive stack. These were large chimneys.

So many conditions affect the cost, including the financial standing of the firm for which the work is done, the freight rates, and labor conditions, that any data of this character are unsatisfactory.

A. D. Williams, Jr.

Comparative cost of 12-foot by 175-foot stack, including foundation and lightning arrester for brick and concrete stack, concrete 100, steel 125, radial brick 129.

B. J. Denman.

For a 100-foot stack with 84-inch flue	$2,475	Concrete
	2,750	Radial brick
	3,050	Red brick
	2,800	Steel
For a 200-foot stack with 96-inch flue	$7,650	Concrete
	8,500	Radial brick
	9,500	Red brick
	5,700	Steel

Above figures are approximate, depending upon conditions.

P. C. Oscanyan.

F 7. What are the principal advantages of a concrete stack?

The durability of concrete exposed to prolonged heat is somewhat problematical, although it will stand tests of short duration at high temperatures. Where concrete has been exposed to temperatures ranging from + 400 to + 1000 degrees Fahrenheit it loses its life, and disintegrates after a term of years. In steel plants experience has taught the danger of using it in any locality exposed to heat unless protected by from 9 inches to 6 or 7 feet of brickwork. Concrete containing limestone is doubly dangerous, as the limestone burns into lime and will cause trouble, particularly when moisture reaches it.

A. D. Williams, Jr.

Cheapness (see F 6), least area at base, tightness, permanency, and no expense for maintenance and repairs.

B. J. Denman.

Cheaper than brick. Advantage not yet proven.

P. C. Oscanyan.

G—PIPING, CONDENSERS, ETC.

G 1. How should the surface of pipe covering be treated so that it can be easily kept clean and made impervious to oil and water?

Three coats of paint and two coats of varnish.

John McFeeley.

Canvas cover should be first saturated with a standard filler; then apply a double coat of paint that will allow the covering to be cleaned off occasionally.

Geo. Ross Green.

We think a coating of an asphalt varnish is as satisfactory as anything, considering price and durability.

F. V. D.

G 2. What is the best material for oil piping in a large oil-circulating system in parts of which the oil may have a temperature of 120 degrees Fahrenheit? Why is plain iron piping objectionable for this purpose? Will pipe galvanized inside answer?

The best material for oil piping in a large circulating system is brass. It is claimed that warm oil will scale iron pipe and have the same effect to a less extent on galvanized pipe.

John McFeeley.

G 3. What is the best material for making tight joints in oil piping?

Rawhide for flanges, and good tight joints without the aid of solder for screw joints.

John McFeeley.

Use a paste made of litharge and glycerine.

J. F. Dostal.

G 4. What is the best kind of gasket for pipe flanges where there is considerable vibration at a pressure of 140 pounds maximum? Rubber lasts only a short time.

If you use extra heavy flanges with bolts of sufficient size and a gasket not over one-thirty-second inch thick, the gasket will stand more vibration than the threads.

W. C. Anderson.

We have had excellent results with tongued and grooved fittings and copper gaskets.

Bennington Electric Co.

Try a McKim gasket. It consists of an ordinary rubber or asbestos gasket bound on both edges with copper, and fits inside the bolt holes. It may be used a second or third time if it becomes necessary to break the joint.

B. E. Morrow.

Would suggest using corrugated-copper gaskets.

J. F. Dostal.

G 5. In a surface condenser, owing to the resistance of the nest of tubes, there is unavoidably a difference in vapor pressure between the point where the steam enters the condenser and the point where the dry air is removed. How low should this difference in

pressure be in a well-designed condenser when operating at rated capacity?

Should be less than one-tenth inch. Some condensers show five-tenths.

J. T. Whittlesey.

G 6. If the condenser (jet) is placed 30 feet from the low-pressure cylinder, will the vacuum gauge placed on condenser head show less vacuum at this point than at a point midway between low-pressure cylinder and condenser head?

Vacuum gauges placed at the low-pressure and condenser ends of an exhaust pipe will indicate the steam pressure at those points. Any difference of pressure indicated will be due to (friction) drop of pressure in the exhaust pipe, hence the pressure midway between the two joints will be higher (assume 20 inches) than at the condenser (say 20.5 inches).

C. J. Embree.

No. There is a loss in vacuum depending upon the length of exhaust pipe and number of elbows and valves. In one of the largest power stations in New York city condensers in the basement were replaced by barometric condensers with the head located close to the low-pressure cylinders, which are vertical, avoiding the loss in vacuum due to the long exhaust pipe and increasing the economy and power developed sufficiently to justify the change.

B. J. Denman.

A better vacuum is usually indicated at the condenser than at the exhaust opening of the low-pressure cylinder, due to the frictional resistance of the steam in the piping.

J. F. Dostal.

Under these circumstances the vacuum gauge should indicate the highest vacuum at the condenser head, the vacuum falling off as the gauge is moved toward the cylinder. Bends in the line will increase this drop very much.

Geo. Ross Green.

G 7. Would a vacuum pump at the end of a series of one-inch pipes for heating a building be of any benefit in helping the exhaust

steam through pipes before condensation takes place, when there is a six-pound back-pressure on the exhaust?

Yes.

Edward Peterson.

G 8. Can temperature of discharge water from condensers be economically reduced to temperature of atmosphere or lower without the use of cooling towers?

It has been found that cooling towers may be done away with by forcing the cooling water through a number of jets placed in a small reservoir.

C. J. Embree.

A cooling pond with an area of five square feet per pound of steam condensed per hour will give as good results as a cooling tower and will entail less loss of power in pumping.

B. J. Denman.

Cooling lakes are used in some places instead of cooling towers. The operating costs are less than with cooling towers, owing to not having to elevate the water. Where constructed artificially, the first cost is usually high.

J. F. Dostal.

G 9. What is relative power taken by auxiliaries when surface condensers are used and when using barometric column condensers?

The barometric condenser should take less power for its auxiliaries than the surface, other things being equal.

Geo. Ross Green.

G 10. Without economizers, which units of a surface-condensing outfit should be operated by motors, and which by steam units?

Steam-operated units are more economical and more easily controlled.

J. T. Whittlesey.

No part of a condensing outfit should be motor-driven, as a rule. The exhaust steam from these auxiliaries will be needed for heating the feed-water.

Geo. Ross Green.

G 11. What is the best literature on the subject of barometric condensers?

Articles in *Power,* January, 1907, p. 1, and February, 1907, p. 91, give elementary principles, effect of air in tail pipes, and describe a number of types.

B. J. Denman.

Patents Nos. 496,716, 511,519, 577,996, 771,515, 588,585 and 588,586, covering the Weiss counter-current condenser, illustrate plainly the operation of this condenser.

Geo. Ross Green.

G 12. Give some good practical applications of the steam accumulator (Rateau, for instance), and give reasons for same, based on actual results.

The first application of the Rateau steam regenerator in the United States is at the South Chicago plant of the International Harvester Company. It is a 600-kw, utilizing the exhaust from reversible rolling-mill engines.

B. J. Denman.

G 13. What is the probable cause of the corrosion of surface-condenser tubes cooled with sea water? What methods have been found helpful for minimizing this corrosion?

Chemical and electrolytic action.

P. C. Oscanyan.

H—ENGINES

H 1. What is the best type of engine for direct-connected dynamos of about 100-kw capacity?

This would depend on the personal preference of the party selecting the engine. Many high-speed engines, such as the Harrisburg, Ideal, Ames and McEwen engines, have proved very satisfactory.

M. C. Turpin.

H 2. How can a loosened foundation cap-stone under main bearing of 650-horse-power engine be made secure without lifting engine from foundation? Impossible to do without engine for over 10 hours

at one time. Engine runs under; would that cause stone's coming loose?

From the information given in the question it is hard to determine exact conditions, but the following plan should remedy the trouble: Scrape as much oil and loose cement from beneath the stone as possible, loosen the nuts on the bolts, make a dam around the stone with damp fire-clay and pour in melted stick-sulphur. When melting the sulphur use a *slow fire* to prevent the sulphur getting too hot, otherwise it will get thick and ignite instead of melting to a liquid nearly as thin as water. The sulphur will set quickly, and within an hour the nuts on the bolts can be tightened; pour sulphur around the bolts, filling to the top of the stone. If the sulphur is given the slightest chance it will penetrate to the bottom of the bolts.

A. T. Lloyd.

I have reset loose cap stones in two ways, and found both very good. First, cut out enough of old joint to drive in iron wedges to hold stone in place, then remove all of old joint. If stone is dry and free from oil, a sulphur joint will remain firm, provided stone is large enough and on good foundation.

If you are troubled with oil, drive a rust joint; the latter I would not advise unless you have had experience in the work.

D. Kennedy.

Can you not drill through the frame of cap stone and down into the foundation? If this is possible, split foundation bolts for about six inches at the bottom, bring to a white heat, insert an iron wedge and drive bolt into hole. When cold fill with sulphur.

B. J. Denman.

H 3. What has been the experience with the Diesel oil engine? Has it proved to be more economical than the Corliss engine? Is it thoroughly reliable?

See *Electrical Age* for March, 1907; description of South Norwalk municipal electric plant.

A. D. Williams, Jr.

H 4. What has been the success of the gas-producer plant and gas engine in electric lighting plants?

We have been operating a 150-hp gas-producer engine for the past twelve months, belt-connected to a 100-kw, 2-phase, 2200-volt, 60-cycle, alternating-current generator. Our regulation is good, frequently running twelve to fourteen hours without a variation of over one to three volts. Our peak load is 13 amperes on each side, and about seven on a side after midnight. We burn 1000 to 1400 pounds of coal each night. We use anthracite pea coal at $8.25 a ton in our bin. We have only one man on each watch and in addition to operating our lighting plant he pumps water for city with a steam plant some 20 feet from our power-house.

Plaquemine Elec. Lt. and Pr. Co.

We have two 80-hp, single-cylinder gas engines of a well-known make, arranged to run from either a producer or an illuminating-gas holder. The engines are each belt-connected to a 50-kw, 2-phase alternator.

The first year the engines were fairly satisfactory, but the regulation was so poor that a Tirrill regulator was installed, which largely overcame that objection. However, despite the employment of skilled gas-engine operators, the engines proved so unreliable that our service could not be depended upon, and we were forced to install a steam equipment. We have abandoned the gas-engine units entirely.

R. H. Garrison.

H 5. What is the most satisfactory method of arranging apparatus for indicating a vertical multi-cylinder gas engine with enclosed crank-case?

H 6. Taking it for granted that the producer-gas engine is the most economical motive power of to-day so far as fuel consumption is concerned, what is the relative maintenance cost per kilowatt-hour of a gas-producer plant, reciprocating engine, steam turbine, and gas engine?

While there is no question as to the economy of the producer engine being far in excess of that of a reciprocating engine, we do not consider it possible at the present time to figure closely on the difference of maintenance, these items being such variable factors in either case.

R. D. Wood & Co.

	A	B
Reciprocating engines	100.00	100.00
Steam turbines	79.64	82.50
Reciprocating engines and steam turbines	75.72	77.00
Producer-gas engine plant	50.67	100.00
Gas engine and steam turbine	46.32	91.20

A—Relative cost of maintenance and operation.
B—Relative investment in per cent.

Extract from: Stott: *Power Plant Economics.* American Institute of Electrical Engineers, January, 1906.

I—TURBINES

I 1. Why has the two-stage Curtis turbine been abandoned and four, five and six stages employed in later designs?

The two-stage Curtis turbine has not been abandoned. The Curtis turbine in its different capacities is to-day manufactured in one, two, three, four and five-stage design, dependent on the conditions of operation and size. The largest two-stage condensing unit that is to-day manufactured as standard is of 500-kw capacity.

Chas. B. Burleigh.

Because of the economical reduction in speed.

John Cyrus Distler.

One of the objects in increasing the number of stages in the Curtis turbine was greater steam economy due to smaller temperature ranges in the different stages, thus increasing the heat loss due to radiation. The Curtis turbine is of the repulsion type, hence the velocity of the buckets is determined by the velocity of the steam. The velocity of the buckets is limited by strength of materials and desirability of slower speed of rotating parts. In order to get this decrease in speed of rotating parts it was necessary to have a lower drop between the pressure of steam entering the nozzles and leaving the buckets, hence the larger number of stages with the total pressure-drop (entering to exhaust) divided up into four or five stages. With the decrease in pressure between stages came the decrease in peripheral velocity of the wheels, hence greater ease in construction, with less liability of accident and slower speed of the generator.

C. J. Embree.

I 2. What is the difference of economy between a reciprocating engine, Atlas type, and a Curtis turbine, 5000-kw units, at their normal load; also the difference in pounds of steam between normal and light loads?

As it is extremely doubtful if anybody has complete data on both reciprocating engines and Curtis turbines to enable him satisfactorily to answer this question in full, I take the liberty of presenting a partial reply. I have no authentic figures of tests of reciprocating engines of the Atlas type. The only test of a 5000-kw turbine of recent design with which the manufacturers were in no way connected is one conducted under the supervision of Mr. W. P. Hancock, superintendent of generation of the Edison Electric Illuminating Company of Boston, Mass., on a three-phase, revolving-field, 6600-volt, 5000-kw Curtis turbine, from which the following results were obtained:

Load, Kilowatts	Gauge Pressure, Pounds	Superheat, Degrees F.	Barometer, Inches	Vacuum, Inches	Water Rate, Lbs. per Kw-Hr.
5195	173.7	142	30.48	29.30	13.57
2575	174.6	146.1	30.11	28.96	14.99

The above figures represent the half-load and full-load performance of the unit. It is to be regretted that conditions were not such as would enable the testing of this unit at the time at one and one-half load, but the relation that the half-load water rate above bears to the full-load water rate is in accordance with the guarantees, and it is reasonable to admit that the one-and-one-half-load rate would also agree with the guarantees, particularly in view of the fact that numerous other tests substantiate the fact that the one-and-one-half load rate on this size unit increases but 0.6 pound over the full-load water rate. It will be noted that these conditions result in producing an almost flat efficiency curve, which is of immense advantage, particularly at extreme overloads, as it is at this point that the high efficiency is of most benefit to the user, for the reason that the ability to supply steam (the boiler capacity) under these conditions is the limiting feature as regards the maximum station output.

Chas. B. Burleigh.

Tests have not shown in regular operation any decided difference in economy between the Curtis 5000-kw turbine and the Allis engine-driven unit of the same size. It would seem that the turbine made up in economy at light loads what is lost at the point of maximum efficiency, or full load, of the reciprocating unit.

Geo. Ross Green.

I 8. Does it pay to install turbines in units of about 500-kw capacity, compared with compound-condensing Corliss engines?

Possibly the best evidence with regard to economy of installing turbines of 500-kw capacity is the fact that on January 1, 1907, there were installed two hundred and thirty-three 500-kw Curtis turbines; 135 different concerns were the purchasers; 55 of these have ordered additional units of the same capacity; some of them ordering as many as eight and ten units. This would tend to indicate that they felt that the 500-kw Curtis turbine was a paying investment. The Chattanooga Electric Company, of Chattanooga, Tenn., has installed three 500-kw Curtis turbines. Its general manager says, under date of March 3, 1905: "Since installing the turbines we have brought the operating expenses down to less than 50 per cent."

The general manager of the Western United Gas and Electric Company, of Aurora, Ill., which has three 500-kw Curtis turbines in service, says, under date of December 2, 1905: "In our opinion a comparison between the Curtis turbine and a large compound-condensing engine is all in favor of the turbine, in every way you take it, floor space, consumption of coal and water, lubrication, repairs and labor."

The agent of the Nashua Manufacturing Company, of Nashua, N. H., says of his 500-kw turbine, under date of July 16, 1906: "We have had no expense whatever in the way of repairs, and were we contemplating the installation of additional apparatus we would certainly install more units of the same character." He has since installed a second unit of the same capacity.

The manager of the Pacific Gas and Electric Company, of Phoenix, Ariz., writes, under date of February 22, 1907, as follows: "From the standpoint of economy, this generator has fulfilled the guarantees made by the manufacturers, and if any addition is made to this plant under my supervision I will be pleased to recommend to further install turbo-generators."

These are extracts from letters written in each case by people whose previous experience had been gained in the operation of large compound-condensing, reciprocating, engine-driven units.

Chas. B. Burleigh.

Yes.

B. J. Denman.

I 4. What difference in steam economy has been found, in practice, between new turbines and the same turbines after running 10,000 hours or more under load of three-quarters rated capacity or over—(a) in Parsons type? (b) in Curtis type? Give size of units.

The Columbus Railway and Light Company, of Columbus, Ohio, has installed a 500-kw Curtis turbine which had been in continuous service on commercial work between 6000 and 7000 hours before it was tested by Professor E. A. Hitchcock, of the Ohio State University, in June, 1904, with the following results:

Average gauge pressure, dry saturated steam	158	pounds
" vacuum	28	inches
" load	519	kilowatts
" water rate per kilowatt-hour	20.5	pounds

This machine was sold under the following guarantee:

Gauge pressure, dry saturated steam	150	pounds
Vacuum	28	inches
Load	500	kilowatts
Water rate per kilowatt-hour	21.5	pounds

This test would indicate that it had not fallen off in efficiency to any great extent.

A record was kept by the Columbus Railway and Light Company of the performance of this turbine some five months later, when the machine had been in operation approximately 10,000 hours. December 14, 1904, the company kept a careful record for the day, operating on an ordinary commercial load, taking the total output from the recording wattmeters and weighing the condensed steam from the station, including all auxiliaries, arriving at results by dividing the total pounds of water by the total output, using dry saturated steam. The following are the results obtained:

Time	Average Steam Pressure	Average Back Pressure, Inches	Average Load in Kilowatts	Average Pounds Steam per Kw-Hour
8- 9 A. M.	150	2.2	128	30.4
9-10 "	149	2.2	120	30.19
10-11 "	155	2.2	121	30.92
11-12 "	153	2.2	85	34.27
12- 1 M.	154	2	279	22.44
1- 2 P. M.	154	2	327	21.22
2- 3 "	154	1.9	445	20.17

Mr. Hopkins, of the Columbus company, says in connection with the above record: "The tests were made while the turbine was working on regular commercial lighting load without any special preparation whatsoever, and showing the actual commercial results which we are obtaining from the turbine under extreme varying load conditions."

Chas. B. Burleigh.

I 5. Boiler makers claim that from 10 to 12 per cent extra fuel is required to obtain 150 degrees superheat. Turbine builders give practically the same percentage in steam economy. Where, then, is the advantage in using superheat?

The conditions surrounding the generation of steam, even in the largest plants, are of such a character that the amount of fuel consumed is not known with any degree of accuracy under operating conditions, due to defective methods of keeping track of the various items affecting fuel consumption. Test results, no matter how accurate, do not govern operating conditions.

There is not a power plant in existence whose manager is able to answer this question and back his answer up by data that will stand analysis. This is because power plants do not have a cost system worthy of the name. In fact, there are very few plants that could afford to go into the refinements necessary to supply a really reliable answer to this question.

Operating results appear to show a decrease in fuel consumption per unit generated when superheated steam is used.

A. D. Williams, Jr.

For attached superheaters, net gain of five per cent. With separately-fired superheaters, no advantage except under certain conditions.

P. C. Oscanyan.

Turbine builders will give a guarantee of 1 per cent saving for every 10 degrees superheat over the economy guarantee on saturated steam.

J. F. Dostal.

I 6. What is the known difference in efficiency of the station where reciprocating engine exhausts direct into condenser and where the reciprocating engine exhausts into low-pressure turbine, which then exhausts into condenser?

I 7. What results have been obtained, so far as economy is concerned, with turbines operating with the exhaust from other units?

The Philadelphia Rapid Transit Company has two 800-kw, single-stage Curtis turbines utilizing the exhaust from five 1500-kw engine-driven units. Surface condensers and cooling towers are used. With one engine in operation one turbine can develop from 60 to 70 per cent of its rating, and with three engines both turbines can develop their rated load.

For three months with the turbines generating 20.9, 23.8 and 23.4 per cent of the total output, the coal consumption in pounds per kilowatt-hour was 3.88, 3.77 and 3.5, respectively. Average for twelve months without turbines was 4.48 pounds of coal per kilowatt-hour. With sufficient turbines to utlilize all of the exhaust the consumption could be cut down to 3 pounds per kilowatt-hour.

B. J. Denman.

I 8. Using a brass-coil, iron-shell, feed-water heater as an oil-cooler for a Parsons turbine oiling system, should the oil be in the body of the heater or in the tubes, and why?

Preferably the oil should be in the tubes, in order to cool it more rapidly and completely. Another reason is that it keeps the oil cleaner.

A. D. Williams, Jr.

It is apparent that where brass piping is specified for an oiling system for good reasons, the oil should run through the brass tubes of the cooler for the same reason. On the other hand, the body of the heater provides greater volume and has the advantage of the exterior radiating surface.

John McFeeley.

With the oil circulating in the tubes, the average distance through which the heat must pass to the cooling medium, which would be the surface of the tube, is comparatively short; with the oil in the shell, this corresponding distance is much greater. A larger supply would be necessary to fill the shell than the coils, hence would recommend that oil be circulated in the coils and the water in the jacket.

J. F. Dostal.

I 9. What are the essential qualities of a proper oil for use on bearings of steam turbines of the Parsons type?

Little, if any, difference has been noticed in using the special turbine oil recommended and the oil used on reciprocating engines.

J. F. Dostal.

I 10. What are the essential qualities of oil to be used on primary valve of Parsons' turbine when steam of 150 pounds pressure and 150 degrees superheat is used, and what is the best method of feeding the oil to prevent sticking of pilot valve?

J—DISTRICT HEATING

J 1. Is there a company operating a combination steam-heating and electric plant, using coal entirely or in part, competing successfully with an electric plant operating from water-power? If so, what are the rates of the water-power company?

Such a thing as "successful competition" is impossible in the average town of 30,000 to 40,000 inhabitants. To be really successful a company should have all the available business at a reasonable rate. When there is competition the business is cut in two, provided both parties show equal intelligence and skill, and the rates are cut below what should ever be offered on a proper basis of allowance for interest, depreciation and operating expenses. As by far the greater part of the expenses of an electric light plant, including fixed charges, are practically unchanged by any increase in output within the capacity of the town, it is plain that by losing both in volume of business and in price both companies are operating on entirely too close a margin in a business where the risks of municipal or legislative interference, from accidents to the machinery and public, and from antiquation of apparatus are so great as in electric lighting.

Any answer to the specific question asked would be very likely to be misleading, as the question of installing a district heating plant depends so largely on the distance of the plant from the centre of distribution, the density of business, price and demand for service, that the results from one plant form a very poor criterion unless all the conditions are known.

H. T. Hartman.

J 2. Do you recommend auxiliary heating plants to be operated by steam or by hot water?

The initial cost of installation is not so great for a heating plant operated by steam as for a hot-water plant, and the results are more satisfactory. Buildings piped for hot-water heating can be readily connected to steam-heating service, whereas buildings piped for steam can not be connected to a hot-water plant without additional expense in changing piping, radiation, and so forth. This alone is well worth consideration in soliciting new business.

L. R. Crawford.

If the heating load is small as compared with exhaust available, auxiliary heating plants can probably most easily be handled with hot water. You have the advantage of no back pressure on the engines, and the ordinary type of closed feed-water heater can easily be installed.

G. N. Tidd.

If for business purposes, steam; but for residence, hot water.

Home Ltg., Htg. and Pr. Co.

I would recommend that auxiliary heating plants be operated by steam instead of hot water, the following reasons being the principal ones, though many others, of perhaps lesser importance, might be offered:

First—Where steam is used it is possible to measure the service furnished to the consumer by the use of a meter. This can not be done where hot water is the circulating medium.

Investigation has fully and conclusively shown that where heating service is furnished upon a flat-rate basis of charge the consumer will use from two and one-half to three times as much heat as is necessary, and as he will and does use when the same service is rendered upon a meter basis of charge. The flat-rate service, therefore, entails increased operating expenses by reason of the greatly increased quantity of steam demanded, for which no adequate return is given; it involves increased fixed charges, by reason of the greater boiler capacity required, and greater investment in underground mains necessary to carry excessive quantities of steam. It cheapens the service in the mind of the consumer, because of the fact that no penalty is involved in his careless use of the service. A flat-rate basis, if made high enough to show a fair profit,. becomes so expensive as to prevent, to a considerable extent, the legitimate and proper enlargement of the company's business.

Second—Because of the greater losses in radiation with hot-water mains in the street by reason of the greatly increased surface of the two pipes, and also by reason of the less thorough means taken to prevent the loss of heat into the surrounding earth.

Third—Greater depreciation of underground mains, due to the pitting effect of the water upon the steel pipe that is ordinarily used in this construction.

Fourth—Greater cost of operation, due to the fact that pumps must be installed, operated and maintained to circulate the water.

Fifth—The limited extent to which the application of hot water for heating may be made. For buildings of two, three or four stories, hot water can be circulated against the static head without particular trouble, but hot water is not especially adapted, nor is it generally used, for buildings of greater height. Hot water can be circulated only through radiation adapted to its use, both in its form and extent. In order to gain a customer whose building is equipped with steam radiation, considerable expense is involved, either to the hot-water heating company or to the consumer, to repipe his building so that this service may be obtained. In either case, this acts as a handicap in securing this class of business.

Sixth—Steam has a wider variety of application. Through the use of an auxiliary heater installed in the basement of any consumer's premises, hot water can be supplied for heating or domestic purposes, the condensation resulting from the heat of the steam to the surrounding water being measured by meter; thus hot-water heating service can be furnished to a customer, if desired, on a meter basis. With trivial changes, steam can be circulated in radiation and piping originally adapted for the use of hot water. Steam can be furnished to large and high buildings, which, if properly piped, will require no more pressure for circulation than a small or low building. Steam may be used for cooking, heating water for swimming pools, baths and other purposes. In these applications, hot water is inherently at a disadvantage.

H. C. Eddy.

J 3. Can steam be used to heat water for domestic use, for swimming pools, and so forth? If so, how, and in what manner should charges be made?

There is no reason why steam can not be used for heating water for domestic use and swimming pools, by the use of coils immersed in water or of ordinary hot-water heater, depending entirely on the amount of water used, and charged for, according to the amount of condensation, strictly on a meter basis.

L. R. Crawford.

Yes. Use ordinary pipe or coil radiation immersed in water to be heated. Best measure the water of condensation and charge for it on this basis anywhere from 50 to 75 cents per 1000 pounds condensation, depending upon fuel cost.

G. N. Tidd.

Our company furnishes both high-pressure steam and low-pressure, the latter for heating purposes; both are used to heat water for domestic purposes by means of steam coils in tank. Our charge is made on condensed steam.

R. P. Bache.

We have a swimming pool that is heated by steam. The water is heated in a closed heater of about 500 gallons capacity. It is then delivered to the swimming pool. The capacity of the apparatus is such that we can keep a steady stream of water running through the heater, and it will be delivered at about 75 degrees or more, as we think necessary.

Walter Flint.

Yes. Use a closed-coil heater, throttle steam so that entire coil can not be heated, permitting cold water to come in contact with outlet end of coil, that the condensed water may be cooled.

Charges should be made by metering condensation.

The Edison Elec. Illg. Co., West Chester, Pa.

(a) Low-pressure steam can readily be used for heating water for domestic purposes by using copper-tubed water heaters at 30 per cent increased capacity over heater used under 40-pound pressure.

(b) We heat the Y. M. C. A. swimming pool—24 feet by 15 feet by 4 feet—by allowing the condensation from the radiation (7000 square feet) to empty into the pool through a perforated 3-inch pipe laid around the wall at the bottom of the pool.

(c) Charges should be by meter, measuring the water as it leaves the radiation for the pool.

Home Ltg., Htg. and Pr. Co.

Steam can be used very successfully to heat water for domestic use, for swimming pools, or even for heating the water of circulation in the radiation of buildings piped for hot-water heating. There are on the market small heaters, of the closed type, especially adapted for this work, which may be used with or without thermostatic control, and which are cheap, efficient and reliable. The charges for this service may be based upon meter measurement, as the condensation that results from the steam imparting its heat to the surrounding water goes through a trap and meter in the usual way.

H. C. Eddy.

J 4. Can steam be used to heat the water for circulation in a system piped for heating by hot water? If so, how? How should the service be charged for?

Any system piped for heating by hot water can be readily connected to a steam-heating plant and operated as such and charged for according to meter rate or square foot of radiation per season, but it would not be advisable to heat the water by steam for circulation in such system.

L. R. Crawford.

Yes. Simply a closed heater. Measure water condensation and charge for it on this basis.

G. N. Tidd.

There are several places where water is heated by steam for hot-water system, tank and coils being used, the steam being used in the coils, water circulating in the tank. As foı economy, it will use more steam than direct steam heat.

R. P. Bache.

Steam can be used to heat water in a hot-water system without any difficulty, the steam heat to be applied in a manner similar to a coal fire. There would have to be some changes made before a furnace could be readily adapted to steam-heat system.

Walter Flint.

Yes. Heaters of this character are made by the American District Steam Company, Lockport, N. Y.

Meter the water condensed and charge for the same.

The Edison Elec. Illg. Co., West Chester, Pa.

Yes, we have experimented with this work and are satisfied that a heater, properly rated, is a success.

Home Ltg., Htg. and Pr. Co.

J 5. Is practically any difference noticed in the effective heating at a given pressure when exhaust steam is used and when live steam is supplied through a reducing valve?

Much better results can be obtained when exhaust steam is used and a lower pressure maintained on steam mains than when live steam is supplied through a reducing valve.

L. R. Crawford.

Yes. Actual experience with large exhaust-heating systems indicates that exhaust steam is more effective than live—probably due to better circulation owing to pulsations of engines.

G. N. Tidd.

At one of our stations we have a district-heating plant. Our experience has been that the best results are obtained with exhaust steam; namely, 5 pounds heats fully as well as 6 pounds live steam through reducing valve.

R. P. Bache.

We have noticed quite a good deal of difference between the effect of a given pressure with exhaust steam and with live steam through a reducing valve, in reaching our consumers at the farthest distance from the heating plant or located on a small main, the difference being in favor of the exhaust steam. Our experience has led us to believe that it would take less coal to do the same amount of heating, if we had sufficient load on our engines for the exhaust to take care of the heating, than to do this heating with live steam through a reducing valve.

Fred Leslie.

The difference I have noticed between heating with exhaust steam and with live steam lies in the fact that exhaust steam will circulate very much better than live steam at the same pressure. This is undoubtedly due to the impulse given when the exhaust valve opens and steam is admitted to the system.

Walter Flint.

No.

The Edison Elec. Illg. Co., West Chester, Pa.

No difference is perceptible in the amount of heat thrown off the radiators at, say, three pounds pressure, and an expert would be unable to tell which kind of steam is used.

Home Ltg., Htg. and Pr. Co.

Yes. Exhaust steam is more effective for heating purposes than live steam at the same pressure. The reason for this is somewhat speculative, and has not been definitely established. Tests have shown, however, that it is a fact.

H. C. Eddy.

J 6. Can you give a brief description of piping under the atmospheric system?

Piping under the atmospheric system consists chiefly in making your mains and risers of sufficient capacity to carry steam and condensation at the same time, also avoiding 90-degree ells wherever possible and providing free and easy passages for steam.

Home Ltg., Htg. and Pr. Co.

The atmospheric system, so-called, derives its name from the fact that the steam is used at practically atmospheric pressure. The pressure is reduced at the service valve from five to eight ounces. The radiation is of the top-connected hot-water type and is so proportioned as to have about 20 per cent more heating surface than would be required under the same conditions for steam in the usual way.

The steam at low pressure, or the vapor, is supplied to the top of the radiator through a valve having an adjustable opening, each setting of the valve corresponding to the admission of a different amount of steam to the radiator. Assuming that the valve has four steps, the first setting would admit steam across the top of the radiator and down to a point equivalent to one-fifth of its effective area; the second setting would admit sufficient steam to heat the radiator from the top down to the extent of two-fifths of its effective area; the third setting, three-fifths, and the full opening, four-fifths; the remaining one-fifth of the radiator deriving its heat from the water of condensation which flows through a small return pipe to a tank or other receptacle in the basement. No air-valves are required, because the air is heavier than the steam and goes out with the return, the only air-valve being the one on the return tank.

The advantages of being able to turn the heat up or down are obvious, and this system has shown very great economy in consumption of steam, because of the fact that in mild weather a less amount of radiating surface is in use, and a very much reduced quantity of steam is used because none of the heat is wasted. It makes an absolutely silent job, there being no possible opportunity for a water-hammer.

H. C. Eddy.

J 7. What are the advantages to the consumer, also to the company, in having buildings piped for and heated by the atmospheric system?

Advantages to the consumer and to the heating company of having the buildings piped and heated for and by the atmospheric system are partially pointed out in my answer to question J 6.

The principal advantages to the company lie in the economy in the use of steam, whereby the expense to the customer is kept at a minimum, and he is consequently a satisfied customer—which in itself is a valuable asset to the company; consequent reduction in main condensation, by reason of the less quantities of steam handled by the underground system; a sharp reduction in the amount of fuel burned and labor used in the milder portion of the heating season. The advantages to the consumer are its economical features and its controllability.

H. C. Eddy.

The service is much more satisfactory to the consumer. Heating expense is about 30 per cent below single-pipe system and the company's service very much more popular.

The Edison Elec. Illg. Co., West Chester, Pa.

The advantage to the consumer is that he is sure of steam at all times, regardless of pressure; to the company, that heat may be supplied with less back-pressure on the engines.

Home Ltg., Htg. and Pr. Co.

J 8. Why is less steam required to heat a building piped under the so-called atmospheric system of piping than where piped under the one or two-pipe steam systems or the vacuum systems?

Assuming that the so-called atmospheric system refers to a low-pressure gravity-return with, say, five pounds initial gauge-pressure at the boiler, less steam would be required, owing to the fact that the greater the steam pressure, the greater the number of heat units per pound.

N. A. Rollins.

Our system is connected to all three systems of piping; we have found that in mild weather the 2-pipe system is as economical as either of the other two.

R. P. Bache.

The atmospheric system uses less steam when a small amount of heat is required, as it can be regulated. The condensation being thoroughly cooled in the radiators, there is no waste by hot water. The greatest saving is made by not overheating.

The Edison Elec. Illg. Co., West Chester, Pa.

Less steam is required to heat a building piped under the atmospheric system than under the one or two-pipe or vacuum system, because for varying portions of the time radiators are not supplied with sufficient steam to completely fill the cubical capacity contained therein. This is not true of either the one or two-pipe direct systems or the vacuum system. The vacuum system derives its chief advantage from an acceleration of the circulation, causing all portions of the radiator to be filled with steam and to become effective in heating. The extent to which the radiation in a building piped with the atmospheric system is filled with steam is within the control of the occupants of the building, or of various rooms in the building, hence, if operated intelligently, much less steam is used.

H. C. Eddy.

J 9. Why is less fuel required to operate the heating plant and the electric plant together, using the exhaust steam for heating, than is required in the operation of the heating plant alone, using direct steam, at which time the usual fuel is also required to operate the electric plant independently? Is it due to a higher value of the steam because it is exhaust, or is it due to better boiler efficiency on account of the continually interrupted flow of steam from the boilers through the reciprocating type of engines and into the heating system, as against the uninterrupted flow of steam through a stationary reducing valve located between the boilers and the heating system? In the above question it is assumed that the generation of steam in the boilers is at the same pressure in both cases. Is there any other reason why such results are obtained? Give experience, if possible.

When using exhaust steam for heating the water of our district heating system we use considerably less coal than when using nothing but live steam. The exhaust-steam heater in our system is installed in the exhaust piping between the engine and condenser. It is an open heater, and the exhaust steam passes through it, then into either atmosphere or condenser, depending on the amount of heat we require. We do not have any back-pressure on our cylinders, and in this way we save the heat units contained in the exhaust steam, which otherwise would be wasted in either atmosphere or condenser. The condensed steam is pumped back into our boilers and furnishes distilled hot feedwater.

Albert Lea Light and Power Co.

We find that exhaust steam passing in waves from the engine gives a more equal pressure all over our system than is given by live steam passing through the equalizing valve. We also find the conditions mentioned in this question, but can not give the reason for them.

Home Ltg., Htg. and Pr. Co.

The reply to this question is indicated in the question itself—that the low fuel consumption required where exhaust steam is used for heating, as compared with that required in the operation of the heating plant alone, seems to be principally due to the fact that for practically four-fifths of the time required for the engine to make one-half a revolution no steam is being taken from the boiler, whereas, where boilers are feeding direct through a reducing valve there is a continuous drain upon them. This period of rest, so to speak, though it be slight, effects a considerable difference in the efficiency of the boiler and furnace, with the resulting increase in economy in fuel. The fact that exhaust steam will circulate better at lower pressure than will live steam may have some bearing on the situation, although the relationship is not known.

H. C. Eddy.

It is due to a higher value of steam because it is exhaust. The pulsating effect of the exhaust from the reciprocating type of engine into the heating system has a tendency to keep the steam alive for a longer period than when live steam is supplied through a reducing valve.

L. R. Crawford.

The ordinary engine, as operated, will not convert over 5 to 7 per cent of the heat of steam into power; the remainder goes to the atmosphere, or if used for heating, to the heating system, therefore practically for each pound of steam used in the engine, 50 B. t. u. are used for power and 950 B. t. u. are available for heating. The demand upon the boiler is therefore only 5 to 10 per cent more when the combination is effected.

G. N. Tidd.

J 10. (a) How much more steam per horse-power, or per kilowatt, is required by engines per pound of back pressure as against exhausting to atmosphere? (b) As against operating under vacuum?

No general answer can be given to this question, as the individual characteristics of various engines vary within such considerable limits. Some compound engines can be successfully operated against back-pressure and others can not, depending on cylinder ratio. In some forms of simple engines, with back-pressures not exceeding three pounds or four pounds, little, if any, difference in pounds of steam per horse-power or kilowatt as compared with exhausting against atmosphere is noticeable. This question can be answered specifically only upon the basis of specific data.

H. C. Eddy.

Actual results with simple automatic non-condensing engines with 5 pounds back pressure, indicate an increase of 15 to 20 per cent in fuel, probably 30 to 35 per cent over condensing conditions.

G. N. Tidd.

J 11. Is a cumulative sliding scale of meter rates the best method of charging for heating service (a) in business, manufacturing and public buildings; (b) in residence heating?

Yes.

The Edison Elec. Illg. Co., West Chester, Pa.

We think not, in either business or residence heating, for it requires a large percentage of loss on the part of the customer to cool off and heat up his circuit. His loss is gain to the plant, and in this latitude a plant using a sliding scale would be unfair to the customer.

Home Ltg., Htg. and Pr. Co.

The cumulative sliding-scale meter rate seems to be the only one in use which even approximates the functions of a proper basis for charging for steam-heating service. Theoretically, the same elements of maximum demand, long and short-hour service, should be incorporated in a charge for steam-heating service as for lighting and power service. It does not seem to be commercially possible to provide a meter for each customer which shall record, either graphically or otherwise, conditions of maximum and minimum demand and length of time during which maximum and minimum demands are extended. There is a meter on the market that records graphically on a strip of paper moved by clockwork a pencil line that indicates the varying demand of the customer and the time through which the demand is made. This meter is too expensive in first cost to be put into general use. The cumulative sliding scale of meter rates takes into consideration some of the factors that compose a proper rate, although it does not do so as scientifically as might be desired. It does, however, accomplish one result very nicely, in that it permits a company to charge a small consumer a higher rate than is charged a large consumer, without discrimination. It also puts the heating company on a better footing, in that, as the consumption increases, the rate automatically decreases. The larger the individual plant, the more nearly will its cost of operation approximate the cost of operation of a central-station plant, and it is a generally recognized principle that the large consumer should be enabled to purchase almost any commodity at a lower price than the small consumer. The theory upon which the cumulative sliding scale is based is less applicable in residence heating than in heating business or public buildings.

H. C. Eddy.

A sliding scale of meter rates seems to be the most equitable method of charging for heating service; but for halls, churches, and buildings that only require heat once or twice a week, a flat rate is preferable.

L. R. Crawford.

Yes. Your investment is heavy for small consumers.

G. N. Tidd.

(a) Yes.
(b) Yes.

B. J. Denman.

J 12. What meter rate will approximately correspond with a flat rate per square foot of radiating surface? Is the meter rate better for small plants?

First 10,000 pounds of water	90 cents per 1000 pounds
Next " " " "	80 " " " "
" " " " "	70 " " " "
" " " " "	60 " " " "
Balance used during the month	50 " " " "

Corresponds approximately to 30 cents a square foot of radiation per season when the required amount of radiation is set. Meter rate is most desirable for small plants.

L. R. Crawford.

Under ordinary average conditions, one-square-foot radiation will consume approximately 700 pounds of steam for the heating season.

From this, equivalent flat rate is easily calculated. Whether meter or flat rate is preferable depends upon exhaust available and prospects for day load. If limited, use meters on live-steam basis.

G. N. Tidd.

(a) Three-fifths of the rate charged per 1000 pounds will about equal the rate per square foot in a building whose radiation is based on 70 degrees zero test.

(b) Yes, unless the exhaust steam exceeds the demand for heat.

Home Ltg., Htg. and Pr. Co.

No general answer can be made to this question. The relation between any given flat rate per square foot of radiation and a meter rate to be its equivalent, can sometimes be worked out in particular cases, though not always. Generally speaking, a meter basis of charge is preferable to any flat-rate method, for either large or small plants.

H. C. Eddy.

It is a hard matter to compare any meter and flat rates. The meter rate is decidedly better for both small and large plants.

The Edison Elec. Illg. Co., West Chester, Pa.

J 13. What is the ratio of average demand per season to maximum demand in district steam-heating plant?

For eight months, 33.5, and 21.3 for a year.

B. J. Denman.

The maximum demand will be more than twice the average demand.

The Edison Elec. Illg. Co., West Chester, Pa.

J 14. What is the shape of the daily load curve in district steam-heating plant for business district? For residence districts?

The accompanying curves (see pp. 68 and 69) give average and instantaneous boiler horse-power and temperatures for seven typical days in November and December in a station in residence district with about 200,000 square feet of radiation connected and 55,000 square feet in mains.

Curves are plotted from half-hourly readings of Worthington displacement meter. In all except November 29 and December 7 and 8, the peak in the evening was caused by engine exhaust being greater than the demand of the heating system, and some steam was thrown to atmosphere. The time of opening and closing of relief valves is shown on curves.

B. J. Denman.

J 15. What proportion of live steam have you found necessary? State maximum electric load and maximum demand for steam for heating purposes.

If the exhaust is sufficient, no live steam is necessary, no matter what the maximum demand may be.

The Edison Elec. Illg. Co., West Chester, Pa.

J 16. Where exhaust steam is used for district heating what portion of the power-house expenses should be charged against the steam-heat business?

Any expense incurred by operation of heating system. If engines could be operated condensing were it not for heating system, the heating system should be charged with extra fuel used due to operating non-condensing. The boiler-room wages, supplies and repairs should be pro-rated in proportion to the fuel chargeable to each system. Extra investment in boilers due to operating non-condensing should be charged to heating system.

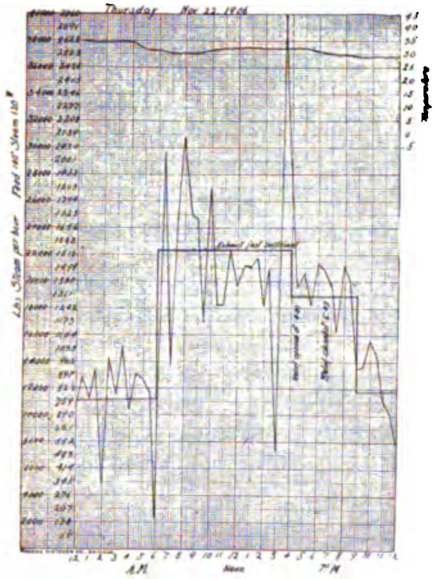


FIG. 1

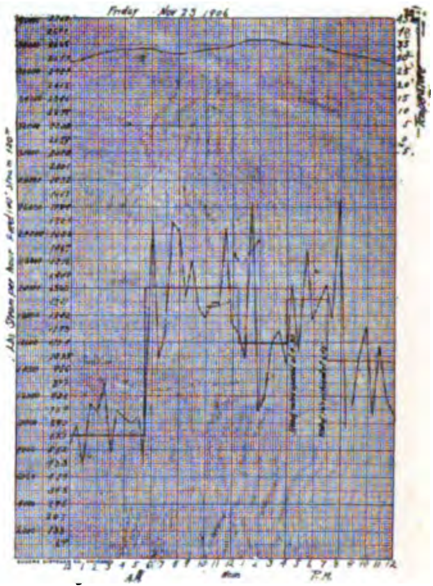


FIG. 2

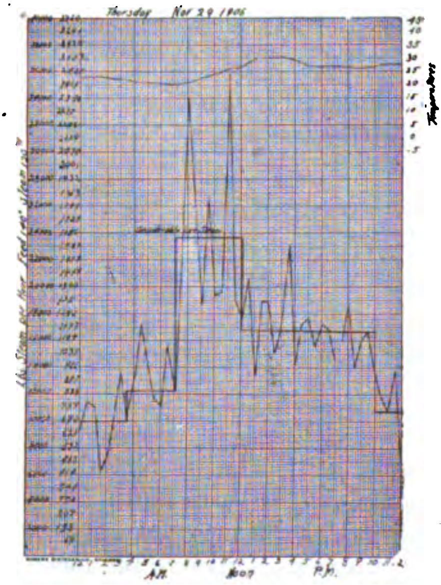


FIG. 3

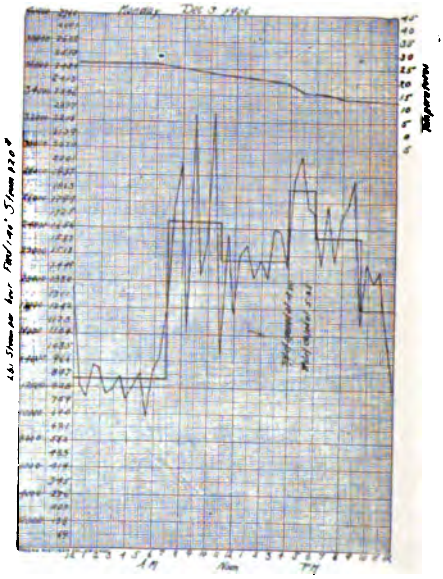


FIG 4

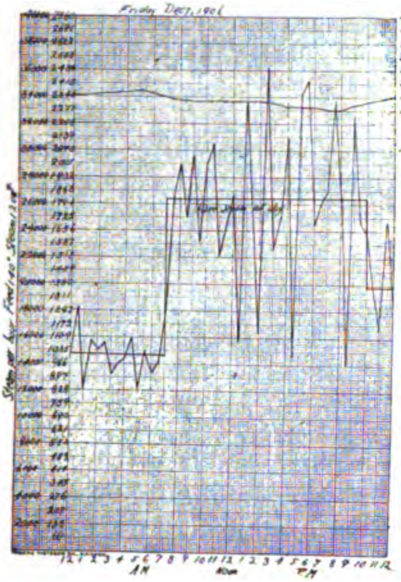


FIG. 5

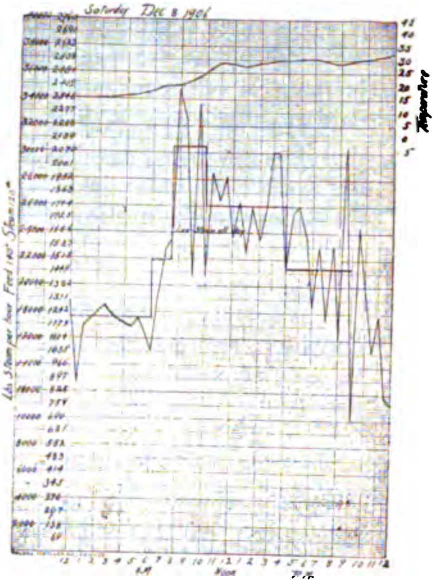


FIG. 6

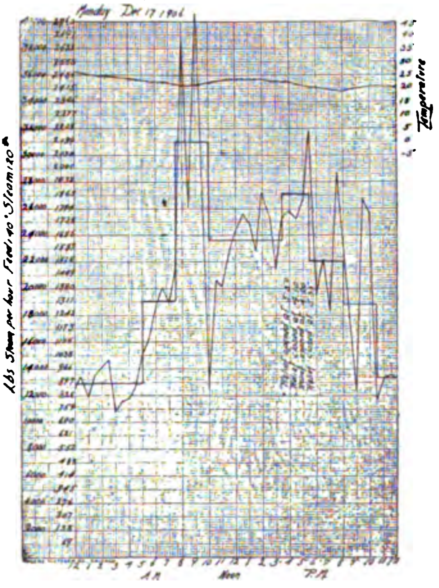


FIG. 7

If engine could not be operated condensing if heating system were not in use, heating system should be charged only with an increase in coal consumption due to its use and a proportionate part of other operating expenses.

The pounds of coal per kilowatt-hour with and without heating system can easily be obtained; the difference is chiefly due to the failure of the heating and electric loads to coincide.

B. J. Denman.

We charge actual labor on heating apparatus up against its operation, and conduct a few tests every winter to arrive at the amount of coal burned for furnishing live steam to our heating system.

Albert Lea Light and Power Co.

All coal and labor used in excess of the amount needed for power, any boilers, real estate, and so forth, not needed by the power plant.

The Edison Elec. Illg. Co., West Chester, Pa.

A formula for proportioning power-house expenses between the electrical and steam-heating departments, where exhaust steam is used for heating, was proposed by the committee on district heating, which reported to the association at the Denver convention. Put in general form, it was as follows:

The difference in station cost per kilowatt-hour during the heating season and the non-heating season should be multiplied by the total kilowatt-hour output for each month in the heating season, the result being the station cost of steam-heating service. To illustrate: If a given plant produces a kilowatt-hour in the summer-time on four pounds of coal burned, and the same station requires during the heating months five pounds of coal burned for each kilowatt-hour of output, then the cost of fuel properly chargeable to the steam-heating department is one pound of coal for each kilowatt-hour put out during the heating season. If this method be used, it makes no difference whether the heating is done entirely with exhaust steam, or with part exhaust and part steam direct from the boilers.

Other station expenses can be proportioned in the same way, as, for instance, labor of firing, handling of ashes, and so forth.

H. C. Eddy.

J 17. In a district heating plant or a plant that furnishes steam for heating a few buildings only, what is the best method of getting at rate of charges for heat consumers of steam?

The only method of arriving at rates of any kind is to base them on costs, including fixed charges, operating expenses and profit.

B. J. Denman.

A rate of 40 cents per 1000 pounds of condensation from pipes and boilers will about equal anthracite coal at $6.00 per ton, in a single-pipe steam system.

The Edison Elec. Illg. Co., West Chester, Pa.

Rates for steam-heating service depend partly upon local conditions, cost of fuel to the consumer, the extent of heating investment, and so forth, but the charge must be based upon the cost of producing and delivering steam at the service valve of the consumer, assuming that live steam only will be used. The rate charged will then carry a certain definite percentage of profit. This profit will be increased (though not in a direct ratio) as the supply of live steam is replaced with exhaust. One fundamental mistake made by many heating companies, both steam and hot water, was to assume that the exhaust steam cost little or nothing and could, therefore, be sold at an extremely low rate. When for any reason live steam was required to be supplied for varying periods of time, the additional expense entailed thereby more than wiped out the slight margin of profit that might be shown on a purely exhaust-steam basis. This statement is repeated—that any rate should be based upon the cost of manufacturing and delivering live steam, even though not a pound of live steam be ever used in the operation of a plant.

H. C. Eddy.

J 18. What is the best method of subdividing revenue received from each individual building where heat, light and power are furnished under a flat-rate charge covering the three commodities? Should recording wattmeters be placed on both the lighting and power circuits and a steam-condensation meter on the heating system, and a proportionate credit be given to each class of service in comparison with the regular meter rates for light, for power and for steam heat, or should the heating branch of the enterprise be credited with

the full amount as shown by meter, and balance received from the consumer be subdivided between the power and lighting accounts?

Connect wattmeter on power circuit and condensation meter on heating service and pro-rate the credit according to the amount actually used in each case.

R. L. Crawford.

Would meter all service, and proportion on income basis.

G. N. Tidd.

J 19. Is there a reliable steam meter on the market?

No.

G. N. Tidd.

J 20. (a) What is your system of charging for steam heat? (b) What are your steam-heating rates? (c) Do you find the steam-heating business profitable?

(a) By condensation meter.

(b) Sixty cents per 1000 pounds condensed.

(c) Yes, if conditions are right. In a plant familiar to the writer, the receipts from sale of steam heat cover all costs of station, fuel, labor and depreciation of plant, and the electric current is a by-product, practically speaking.

Edward Peterson.

(a) We operate a hot-water heating plant, and charge flat rates only.

(b) Our rate is 22.5 cents per square foot of radiation installed.

(c) Depends entirely on local conditions, as climate, rate, amount of business, cost of coal, and last, but not least, the amount of exhaust steam available.

Albert Lea Light and Power Co.

(a) Meter and flat rate
(b) First 10,000 pounds of water ....90 cents per 1000 pounds
Next " " " " ....80 " " " "
" " " " " ....70 " " " "
" " " " " ....60 " " " "
Balance used during any one month, 50 " " " "

Discount of 5 per cent if paid on or before the tenth of the month. Also 50 cents per square foot of radiation per season to a few small consumers.

R. L. Crawford.

Flat rate 25 cents per square foot. Remunerative if conditions are good.

G. N. Tidd.

K—GENERATORS AND EXCITERS

K 1. In an extensive system to best insure continuity of service and at the same time not make an unreasonable investment charge at any time, what ratio should exist between the generating capacity and the actual maximum load carried?

We have tried to keep about 25 per cent of our total capacity as a reserve to be used in case of breakdowns to apparatus. Our units are of such capacity that a 1000-kw steam turbine, held as a reserve, has generally been enough to take care of emergencies on alternating current, and we try to keep about the same proportion as reserve on direct-current apparatus.

United Electric Light Co.

To give the best assurance of continuity of service, would advise sufficient capacity to carry the maximum load with the largest unit out of service.

W. C. Anderson.

In plants with a pronounced peak of short duration it would be reasonable to install sufficient generating apparatus to handle the maximum load with the largest unit in the station disabled and a rise in temperature of not more than 55 degrees centigrade in any part of the remaining machines.

H. H. Barnes.

The sizes of units would have somewhat of a bearing on the ratio between the generating capacity and the actual maximum load carried. With certain sizes of units this ratio would necessarily be made smaller. I should say, for example, that a plant with a maximum load of 2200 kilowatts and having already installed three 750-kw units should have not less than 1000 kilowatts extra capacity.

F. C. Sargent.

The generating capacity in all important stations should be sufficient to carry peak of load with operating units running at 25-per cent overload when one unit is out of commission. The minimum number of units most desirable depends somewhat on the length of the peak.

Geo. Ross Green.

In modern power plants with four or more units it is not necessary to provide reserve generator capacity, as the overload capacity of the machines will easily carry the load in case of accident to one. As the number of units increases the ratio may safely be reduced to less than unity, working all generators beyond rating on peaks. Of course the load-factor will affect the ratio; the shorter the peak, the greater the allowable overload, and *vice versa.*

B. J. Denman.

K 2. How much greater capacity, if any, should the distributing system have than the generating system?

The capacity of the distributing system may have to be considerably greater than that of the generating system, depending upon load conditions. Each feeder must be able to safely carry its maximum load.

The maximum load on the generating system, however, will be less than the sum of the maximum loads on the feeders, as the latter occur at different periods of the day, depending upon the character of the neighborhood supplied by the individual feeders.

H. H. Barnes.

This is greatly dependent on the percentage of growth of a plant from year to year. I do not think it is necessary to have any more capacity in the distributing system than in the generating system, as the generator equipment is usually added to as the plant grows, and the distributing system should be added to in the same way.

F. C. Sargent.

It would appear that the distributing system ought to have capacity equal to the maximum overload capacity of the generating system.

F. V. D.

K 3. In connection with a rotary-converter equipment employing regulators, what has been observed to be the limiting feature concerning maximum capacity of same?

K 4. In cases where the regular operating procedure of shutting down a rotary-converter unit equipped with an induction regulator provides for opening the fields of the converter before it comes to rest, has trouble been frequently experienced in subsequently starting the converter from the direct-current end, due to the residual magnetic condition of the static transformer?

As a protection against internal shorts due to accidental grounding of live parts of the generator winding, it is customary to place the circuit-breaker on the negative or ground side. This breaker is mounted on the generator panel, and with it the ammeter. If the series field-windings were also on the negative side, it would be necessary to run a direct lead from the negative brush-studs to the board to get the full armature current through the ammeter before it has a chance to split up through the series winding and the equalizer connection. This would mean a return lead from the board to the machine to carry the current back to the series winding. The complication and duplication that this involves are done away with when the series winding is connected in on the positive side. With rotaries the opposite practice is usually followed, both in regard to the location of the circuit-breaker and of the series winding, as rotaries are considered to be sufficiently protected against internal shorts to ground by the automatic switch features on the alternating-current end, even when the direct-current breaker is on the positive side.

H. H. Barnes.

K 5. What has been the experience of large companies operating numerous large rotary converters as to the comparative merits of staggering every other set of direct-current carbon brushes on direct-current side with reference to each other, or of staggering by groups of adjacent positive and negative brushes with reference to each other, the latter method of staggering being done for the purpose of avoid-

ing the uneven wear on the commutator due to electrolytic deposition of copper on the face of the positive carbon brushes from the copper commutator immediately under the brush face?

K 6. What has been the experience of those who have used in practical work a system of automatic synchronizing of rotary converters?

The possibilities of a good attendant should not be overlooked in considering any form of automatic device.

H. H. Barnes.

From observation in one plant that has come under writer's notice, this seems very satisfactory.

M. C. Turpin.

K 7. In compound-wound rotary converters do the results obtained with series reactances justify their installation? What maximum per cent of over-compounding can be secured in practical operation by their use, and what method of operation of the rotary-converter set, as regards suitable power-factor for mean loads, gives best results?

Compound-wound rotary converters are not commonly used except when the generators supplying the converters have very nearly the same rating. The increase in the field flux due to compounding affects both the direct-current and the synchronous-motor side of the machine, and the latter effect causes the power-factor of the transmission line to vary. The synchronous motor will break down if the field flux becomes too great. This effect may be counteracted more or less effectively by using inductive regulators to control the voltage on the motor.

There is also more chance of trouble from hunting in this machine.

John Cyrus Distler.

It is not difficult to obtain 10-per cent compounding in rotary converters by the use of choke-coils and properly-proportioned series coils. It is customary to operate so that the power-factor at full loads is practically unity; at less than full loads power-factor will be lagging, and at greater than full loads power-factor will usually be slightly leading.

P. M. Lincoln.

K 8. Why not use compounding rotaries in light and power substations?

It is usually unnecessary to compound rotaries in light and power substations, because the load usually comes on and off gradually and gives the switchboard attendant time to regulate the voltage by other means.

M. C. Turpin.

K 9. In operating several high-voltage 3-phase generators in parallel, is it desirable to ground the neutral of more than one generator?

Yes, if the characteristics of the generators are the same.

B. G. Jamieson.

Practical experience in several plants has shown that it is not advisable to ground the neutral of more than one of a group of 3-phase generators when operating in parallel.

P. M. Lincoln.

It would seem best to ground all three; as this would, in addition to insuring a better path to the ground, be essential in case the grounded machine were out of service. It would also seem better to ground the neutral 'bus-bar, as this would insure the ground in case any one of the machines were running.

M. C. Turpin.

K 10. Is it now considered the best practice to ground the frame of any generator of a potential sufficiently high to be dangerous to life?

We think it is a good plan to ground the frames of all generators and other high-voltage apparatus, such as step-down transformers, and so forth.

United Electric Light Co.

Yes.

J. T. Whittlesey.

No.

J. A. Lane.

All generators having voltages high enough to be dangerous to life should be sufficiently well insulated to allow grounding of the frame.

C. E. Skinner.

The writer makes a practice of grounding all apparatus where the potential is sufficiently high to be dangerous.

F. C. Sargent.

Yes, by all means, as otherwise the attendant is liable to receive a shock, having to depend only on the insulation of the frame under the machine.

M. C. Turpin.

K 11. Is a very close speed-regulation of prime movers desirable in the parallel operation of alternators?

Not only desirable, but imperative.

J. A. Lane.

Close speed-regulation of prime movers driving alternators is not desirable, for the reason that it is difficult to obtain proper division of loads between various alternators in that case.

P. M. Lincoln.

Too close governing is not only undesirable, but in some cases it prevents parallel operation of the generators. The writer has in mind two small direct-connected 60-kw units of different sizes and speeds which can not be made to run in parallel owing to the fact that the engine governors regulate too closely.

M. C. Turpin.

In most engine-driven units a speed regulation closer than four per cent is generally undesirable.

Geo. Ross Green.

No.

B. J. Denman.

K 12. Assuming two or more alternating-current generators feeding into a common 'bus-bar without automatic circuit-opening devices in the leads from the individual generators, what would happen (a) if,

for any reason, the field of one generator should die out, (b) if the operation of an automatic speed-limit device should shut off the steam from one of the generators?

(a) The other generator would have the load.

(b) Same as in case A.

J. A. Lane.

(a) Were the field of one of the generators to die out, a very large cross-current would immediately flow between the generators, and the 'bus-pressure would drop very materially. This cross-current would have a low power-factor and would be leading in the open-field generator and lagging in the others. It would undoubtedly be heavy enough to do damage to the circuits over which it flows, resulting in a shutdown of the system unless the open-field generator were disconnected in time.

(b) The effect on the steam end would be the blowing of the safeties on all the boilers of that unit unless the headers were cross-connected with the others. On the electrical end the result would be a drop in 'bus-pressure and an increase in load on the other units. The unit having its steam energy cut off would continue to revolve, but as a synchronous motor. Due to the change in relative load, there would also result an interchange of cross-current, the amount of which would depend on the load and the field excitation.

R. F. Schuchardt.

(a) If sufficient number of generators are in circuit, the only result will be a drop in voltage and a very excessive current passing through the generator whose field has been opened. If few generators are in, the generator whose field has been opened will probably pull out of step and cause a practical short-circuit on the 'bus-bars.

(b) If remaining prime movers are sufficient to carry the load nothing whatever will occur. The engine whose steam has been shut off will continue to run, being driven by the generator as a synchronous motor. If the remaining engines are not sufficient to carry the load there will be a drop in speed and voltage.

P. M. Lincoln.

(a) Generator would lose its load, which would have to be assumed by the remaining generator or generators. It would, of course, depend upon the remaining machines whether or not they could successfully carry this load: the generator, having lost its field, would fall out of step and would tend to run as an induction motor, taking considerable current from the 'bus-bars, which would undoubtedly cause a disturbance in the remaining machines.

(b) The generator would fall out of step and, of course, lose its load; practically the same thing would happen as in the first-mentioned case.

M. C. Turpin.

(a) Generator would continue to run as an induction motor with at least full-load current at low power-factor.

(b) Generator would continue to run as synchronous motor.

B. J. Denman.

K 13. What will be the effect of running our 3-phase alternators unbalanced? We have two 200-kw, 3-phase machines, both direct-connected to one wheel shaft. One alternator then has practically only two legs in use, transmitting current at 11,000 volts twelve miles, the other single-phase; the other alternator transmitting current ten miles at same voltage 3-phase.

In absence of more definite information regarding the condition, it is assumed that the unbalance refers to the varying load on either one or both of the alternators. Under this condition I should say that both alternators are affected so far as turning movement is concerned, the magnitude of which depends on how closely the governor of the water-wheel regulates.

C. A. Keller.

We have a hydro-electric station at Schoharie Falls containing two 750-kw Stanley inductor alternators. We use a Tirrill voltage-regulator and it has given excellent service.

B. E. Morrow.

So long as safe operating currents are not exceeded, the only trouble should be in obtaining satisfactory voltage regulation at the end of the 3-phase line.

Geo. Ross Green.

K 14. In two lighting circuits running from one 140-cycle, single-phase, compound-wound alternator, with amperage equal on both circuits, the pressure differs from two to four volts. What causes it?

If the difference in voltage is at the distant end it may be caused by the drop, or by various conditions. Of course, there could be no such variation at the switchboard.

J. A. Lane.

This may be caused by the difference in the resistance and the inductance of the two circuits.

J. S. Reesman.

I should judge from this statement that a separate potential transformer or separate voltmeter is used on each circuit. If so, it is very possible that there is a difference in the ratio of the transformer or the accuracy of the instrument that causes this difference.

F. C. Sargent.

Evidently the measurements taken were on the feeder circuits. You were measuring the drop of the individual circuits, which, of course, would vary with the induction of the line. One circuit, undoubtedly, has more inductance or resistance than the other.

M. C. Turpin.

Probably caused by self-induction of the lines.

Geo. Ross Green.

K 15. What experience have central stations had with Tirrill or Chapman voltage regulators on inductor alternators, belted, load being induction motors and lights?

Tirrill regulator is very satisfactory.

Edward Peterson.

Induction-alternators, especially with an inductive load, appear to be quite sluggish, while the Tirrill regulator is instantaneous. However, Tirrill regulators can be made to give satisfactory results with an inductor-alternator if properly adjusted.

M. C. Turpin.

We have recently installed a Tirrill voltage regulator on a 420-kilowatt inductor alternator, and get excellent results as long as the exciter voltage is no higher than that marked on the name-plate.

W. O. Haymond.

I was connected with a plant containing 200 kilowatts in inductor alternators, belt-connected to high-speed engines. The power load was composed of about 100 horse-power in single and 2-phase induction motors, ranging in size from 1 to 15 horse-power. After the installation of a Tirrill regulator the regulation was very satisfactory.

R. H. Garrison.

K 16. Explain how a synchronous motor takes up the induction on a transmission line and whether it takes more induction running idle or under load.

By varying its field excitation a synchronous motor may be made to take either a leading or lagging current. With over-excitation the current taken is leading and thus affords compensation for lag of current resulting from inductance in the line. The motor then acts as capacity load. The amount of line reactance to be compensated for will determine the extent of the over-excitation. The range of over-excitation of the motor is, of course, greatest at no load, but with the usual reactance met with in practice, even on fairly-long aerial lines, most motors have sufficient range under load. The low power-factor due to over-excitation, however, reduces the output capacity of the motor.

C. R. Wylie.

The synchronous motor, when its field is excited beyond the amount that will give normal operating voltage, takes a leading current from the system to which it is connected. This leading current neutralizes lagging current, such as is taken by induction motors and similar apparatus. An unloaded synchronous motor will do somewhat more neutralizing than one with load, depending upon the inherent regulation of the motor.

P. M. Lincoln.

A synchronous motor raises the voltage at the end of a transmission line and also at the generator in proportion to its field strength. Its ability to do this is limited only by its ampere capacity. Thus an empty motor excited strongly to give maximum current allowable is of more use in this particular than one that is partly loaded and therefore can not give the same amount of leading current without exceeding the safe output of the machine.

Geo. Ross Green.

It is due to the fact that the counter e.m.f. may be less, equal to or greater than the impressed e.m.f. Although the speed is synchronous the counter e.m.f. is not in exact proportion to the impressed, but lags behind it and this lag increases with the load, decreasing the component of the counter e.m.f. which is in opposition to the impressed e.m.f., and permitting more current to flow through the armature.

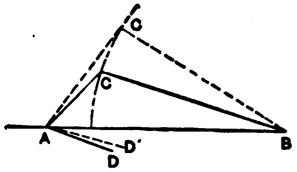


FIG. 1

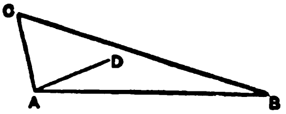


FIG. 2

In Figure 1 let *AB* equal the impressed e.m.f. and *CB* the counter e.m.f. which is not in direct opposition to the impressed. The resultant which is effective in causing current to flow is *AC*. If the resistance and the inductance of the armature are known the impedance may be found, and from this the current, also the lag of the current.

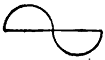
Lay off this angle of lag, *CAD*, giving the direction of the current with respect to the impressed e.m.f., behind which it lags by the angle *BAD*. If the load increases, the excitation remaining constant, the armature will sag still more, say to position *BC*, the effective e.m.f increasing to *AC*; increasing the current and hence the torque, the current taking the position *AD*, more in phase with the impressed e.m.f. The angle of lag, *BAD*, will continue to decrease with the load until *AC* becomes tangent to the circle with *BC* as a radius, and decreases with any greater load, so that with constant excitation the power-factor increases up to a certain load and then decreases.

If the excitation be increased the counter e.m.f. may become greater than the impressed, as in Figure 2. Laying off the current with the same lag, *CAD,* behind the effective e.m.f., it is seen that the current leads the impressed e.m.f. by the angle *BAD*. By decreasing the excitation sufficiently to cause line *AC* to revolve through an angle equal to *BAD,* the line *AD* will coincide with the line *AB* and the power-factor will be unity, so that by varying the excitation the current may be made to lag or lead or be in phase with the impressed e.m.f.

B. J. Denman.

K 17. Will some one give a definition or explanation of the term "phase" as used in alternating-current work, so it can be made clear to the ordinary non-technical customer?

Explain that the current flows first in one direction, then reverses, and show the usual diagram for a complete cycle



showing the appearance or phase of the current.

J. A. Lane.

A phase is a single current composed of alternations or waves. A single-phase current is a simple current having one set of these waves. A multi-phase has two or more sets of such waves, which start from a generator a certain distance apart and maintain this relative distance throughout the circuit. A split phase is a current in which a single phase is split in two parts, one part being retarded or advanced to give the same effect as a 2-phase current. The 2-phase current obtained by splitting is an imperfect current as compared with a true 2-phase current originally generated as such.

C. R. Meston.

The best explanation to give a "non-technical customer" would be in terms of the wiring and of the general characteristics. For instance, a single-phase circuit, if 3-wire, has the same pressure between each outer wire and the middle or neutral and double this pressure between outer wires. A single-phase motor requires special starting devices, and so forth; then similar simple explanation of 2-phase and 3-phase wiring, motor characteristics, and so forth. To explain the actual meaning of "phase" in its proper terms of time element and sequence, while simple to the engineer, would befog the non-technical customer. In explaining the lag or lead of the current with respect to its pressure with which it is out of phase, it is again more satisfactory to explain the results rather than the wherefore, as no explanation would be entirely satisfactory unless some of the fundamental principles of alternating current were first made clear.

R. F. Schuchardt.

K 18. Give a short explanation of the necessity for a large air-gap in turbine generators.

To prevent the armature teeth from magnetically distorting.

J. A. Lane.

Turbo-generators having usually very few poles have, as a consequence, a very large number of armature ampere-turns per pole. This causes a large armature reaction. In order to decrease the effect of this armature reaction, large air-gap is necessary.

P. M. Lincoln.

The number of poles for a given frequency varies inversely as the speed, consequently there are not so many poles in turbines as in engine-driven machines. The output for large engine-driven alternators seldom exceeds 125 kilowatts per pole and is usually much less.

In a 2-pole 3000-kw turbo-alternator running at 1500 revolutions per minute, the output is 1500 kilowatts per pole. With a small air-gap only a small magnetizing force is required and the armature reaction will be excessive and the generator will have no inherent regulation. With a large air-gap the armature reaction would be reduced and the magnetizing force would have to be greatly increased, giving a stiff field not susceptible to armature reaction. In a machine of this capacity and speed the air-gap would be two inches or more.

B. J. Denman.

The reason for large air-gap in a turbine generator is clearly shown by an article in the *Electric Journal* of June, 1904, p. 301.

Geo. Ross Green.

A turbo-generator to possess the same inherent regulation as a typical low-speed generator of equal output must have a larger air-gap, due to the demagnetizing action of the armature on the field. This latter effect increases with the output per pole, since the ampere-turns of the armature before each pole increases in the same proportion. It decreases with the intensity of the field in the gap, and here the turbo-generator is again at a disadvantage. since the area of the pole face at the gap is much greater than that of the section embraced by the field-coils. This condition is necessary to support the field-coils against a large centrifugal force. In a low-speed type these two sections of a pole are very nearly equal. The demagnetizing action of the armature is reduced by increasing the air-gap, since the reluctance of the magnetic circuit is greatly increased, two gaps being in series. The increased watts necessary for field excitation is sacrificed to obtain better regulation.

John Cyrus Distler.

K 19. In changing from Brush lamps, 9.6-ampere, to magnetite lamps, which is the better—to use mercury-arc rectifiers or rewind Brush machines?

Rewind machine.

J. A. Lane.

Use mercury-arc rectifiers. This does away with shafting on small engines and modernizes the plant.

W. W. Titzell.

The writer would use the mercury-arc rectifier, as he thinks it makes a much simpler system and in a direct-connected plant does away with all rotating auxiliary apparatus, with the exception of the exciters.

F. C. Sargent.

K 20. For 2300-volt, 3-phase, revolving-field generators, (a) which type of armature slot do you prefer? (b) How should the coils be insulated and placed in the slots?

Open slots, formed coils, insulated from iron with standard pressboard slot insulation. Coils themselves are insulated by oiled cambric. Inside and next to the copper is generally a double cotton covering, treated with proper insulating compound.

Geo. Ross Green.

The matter of selection of type of slot for alternating-current generators lies between the partially-closed slot and the open slot. The former gives higher efficiency and better regulation and the latter gives greater ease of repair. It is a question, therefore, of better performance on one hand as against ease of repair on the other. In the open slots coils may be insulated and dropped into place, while on the partially closed the coils must either be wound in place or else wound and insulated and then shoved through the slot and connected at each end.

P. M. Lincoln.

K 21. A newly-installed alternating-current generator does not generate and the coils are short-circuited. How may the defect be located?

Run the machine with a low field charge and feel the various coils on the machine from time to time. The defective coil will soon begin to heat up under such treatment.

P. M. Lincoln.

First, see if the field circuit is closed and if the proper amount of direct current is flowing therein. This should be about two or three per cent of the full load of the alternator. If the field circuit is all right, take the drop of potential across each one of the field spools and see if they are practically the same. It is possible some of the fields are short-circuited and are producing no magnetism. Of course the current should be held constant while making this test. Ring out the armature connections of the three terminals and see if there is a circuit between each pair. Test the polarity of the fields by means of a compass, seeing if they are alternately north and south. It may be that they are improperly placed and the similar ones are adjacent to each other. We believe that if the above methods are tried the trouble will be discovered.

M. C. Turpin.

K 22. A ring armature contains a defective coil. What temporary remedy would be possible, so that the motor could be operated?

Jump the defective coil at the commutator and cut out the windings to prevent burning the adjacent coils.

J. A. Lane.

Open-circuit the defective coil and put a jumper around it.

P. M. Lincoln.

Disconnect damaged coil from commutator and tape up and secure each end to avoid circuit in this coil being closed. Short-circuit commutator bars to which damaged coil was connected, by soldering jumper where leads were connected.

B. J. Denman.

Defective coil must be removed and gap properly bridged. The machine should then operate fairly well.

Geo. Ross Green.

K 23. If two generators, one of 650 volts and the other 625 volts, were connected up in parallel, what would be necessary to make them equalize properly, provided the machines were equalizing on negative side?

To equalize two generators properly under these conditions a resistance of suitable capacity should be inserted in the positive lead of the 650-volt machine.

N. A. Rollins.

Place a german-silver shunt across the series field of the 650-volt machine until it has the same compounding characteristics as the 625-volt machine. Then throw them into parallel.

M. C. Turpin.

This necessitates the 625-volt machine being run above voltage or the 650-volt machine below voltage, or both, if 637.5 volts are carried. In either case the 650-volt machine would operate with the weaker field and hence be more susceptible to change in field strength than the other machine, consequently the change in current in series field should be less than in the other. This effect may be secured by inserting resistance of sufficient current-carrying capacity in series with its series field-coil.

B. J. Denman.

K 24. What are the advantages and disadvantages of using equalizing connections on the negative polarity of compound-wound, direct-current generators for railway service?

It has been customary in the past to put the series coils of compound-wound, direct-current railway generators on the line side. The reason for this practice has usually been assigned to the protection from lightning that the series coil gives, being, as it is in this case, between the armature winding and the line. Just how much protection from lightning this arrangement gives is problematical. Many modern stations are using the single-'bus system and thereby avoiding considerable complication in switching apparatus.

P. M. Lincoln.

Balancing load.

P. C. Oscanyan.

K 25. In an exciter system, which are more satisfactory—compound or shunt-wound generators, there being no battery in the system?

Compound generators.

H. Clyde Parrish.

Compound-wound generators are preferable for an exciter system. The writer always has these exciters flat-compounded; that is, 125 volts no load, 125 volts full load.

F. C. Sargent.

Compound gives better regulation.

B. G. Jamieson.

A compound-wound exciter is much to be preferred, for the reason that maintaining a constant speed the pressure of a shunt generator will drop with load. As the load is increased on the generator excited it requires a stronger field and consequently adds to the load on the exciter, which tends to drop the voltage, thus tending to aggravate the conditions, until adjustments are made by means of the rheostat. The reverse is the case with a compound exciter, which may be flat-compounded or overcompounded to meet local conditions. As load comes on to the excited unit, calling for a stronger field, thus imposing more load on the exciter, more current immediately flows through the series coils, holding the exciting voltage if the exciter is flat-compounded or raising it if overcompounded.

Chas. B. Burleigh.

Most of the exciters now furnished are compound-wound, but if they are used with a Tirrill regulator the shunt-wound exciters are much preferable.

M. C. Turpin.

Compound-wound exciters are much more satisfactory unless each generating unit has its own exciter, direct-connected or belted, in which case shunt machines are to be preferred.

Geo. Ross Green.

K 26. In putting a generator out of service, to how low a value is it customary to carry the voltage (that is, what percentage of normal voltage) before breaking the fields?

The rheostat we use is capable of lowering the voltage to within about 15 to 20 per cent of normal voltage, and is all cut in before breaking the field. Field-switches are equipped with discharge resistance.

F. C. Sargent.

There is no general rule. Operators generally turn the rheostat all in. Since the fields are usually opened through a discharge resistance, it really makes very little difference whether the voltage is cut down or not. Designers do not usually include enough resistance in generator field-rheostats to reduce the voltage more than 50 per cent.

B. E. Morrow.

Field-charge should be carried to as low a point as possible. If a field-discharge switch is installed it will do no harm to open the field at full value. However, it is better to avoid any chance of danger by reducing field strength as low as possible before opening.

P. M. Lincoln.

It would depend on the size of the machine and the inductance of the fields. Should say roughly reduce the voltage to approximately 50 per cent of the normal value.

M. C. Turpin.

Drop voltage to lowest possible value; drop it entirely, if possible, before breaking field.

Geo. Ross Green.

K 27. When and how frequently do station engineers need to reduce the voltage of a generator to as low as one-half the normal no-load value?

Reduction of field current to one-half the normal no-load value is very rarely called for, except possibly in cases of variable-speed direct-current control. At the same time, with alternating-current machines it may become necessary to cut down the field temporarily to even less than one-half of its normal value, for the purpose of drying out the coils after installation or for evaporating moisture contained in and around coils that have been exposed to dampness. Reduction for a very short period may also be needed in perfecting the adjustment of voltage regulators.

H. H. Barnes.

Do not know of any circumstances that would require such a condition.

B. E. Morrow.

K 28. How much power is gained by direct-connecting instead of belt-driving?

The loss in belt friction is saved, and in a three-bearing set about 25 per cent of the bearing friction is saved also.

B. E. Morrow.

It depends altogether on the belting used.

M. C. Turpin.

K 29. What is the best metal for bearings on dynamos?

Babbitt is almost universally used for bearing metal on electrical apparatus.

P. M. Lincoln.

K 30. What are the objections, if any, to using air suction instead of air blast for cleaning electrical apparatus?

Air suction has a maximum possible pressure (or suction) of less than 15 pounds, which is not sufficient to dislodge dirt from deep crevices. It is also impossible, and would be dangerous, to have the suction nozzle reach into crevices around electrical apparatus, and unless the nozzle comes into very intimate contact with dirt and grease it will not remove it by suction. A high-pressure air blast of 60 to 80 pounds is much more effective for dislodging dirt and grease.

C. R. Meston.

I do not see any objection to using air suction for cleaning, and think it would be preferable to air blast.

F. C. Sargent.

This scheme does not appeal to us as practical in cleaning car and station apparatus, and the additional cost is excessive. Another objection is that in cleaning apparatus where it is impossible to get the nozzle close to the surfaces to be cleaned the vacuum system does not work effectively. The cross-sectional area of the suction nozzle would have to be large in order to be effective, and this would necessarily reduce the suction pressure and would not be as effective in removing dust from the apparatus as would a high-pressure stream of air directed on the parts, which blows the dust and other foreign material away. I think the point that the suction cleaner has to be placed very close to the surfaces to be cleaned would be a serious drawback to the application of this method of cleaning generators, control apparatus, and so forth, where you can readily appreciate that the irregularity of construction in the apparatus would not permit close application of the nozzle to the surfaces which it is desired to clean.

A. V. Thompson.

Not practicable, as our experience has shown that the dust particles which become lodged in the inaccessible interstices or ventilating ducts can not be removed unless they are disturbed in some manner.

C. A. Keller.

L—STORAGE BATTERIES AND BOOSTERS

L 1. Give records of largest storage battery plants, showing utility of same.

The largest of the earlier storage-battery installations for central-station service were those in Chicago, New York, Hartford, Philadelphia, Buffalo, Cincinnati, Brooklyn and Indianapolis, these plants having been installed from 1896 to 1900. At that time, it was the usual Edison practice to charge the batteries during the hours of light load, and to discharge them to assist the generating apparatus during the hours of peak load. While this method of operation is still followed in many cases, large batteries are now more generally held in reserve, to be used for the purpose of carrying the load under emergency conditions.

Chas. Blizard.

L 2. How does bulk compare with capacity in storage batteries?

Directly, in batteries of the same character. For vehicle cells this capacity is, roughly, one-half ampere-hour for each cubic inch of battery; for stationary batteries about 0.2, and for large stationary batteries about 0.15 ampere at the 8-hour rate of discharge per cubic inch of complete cell.

Hugh Rodman.

Capacity in storage batteries of the same type is practically proportional to the bulk.

Bruce Ford.

L 3. What is the average life of positive plates in terms of equivalent complete discharges?

The average life of positive plates is best given in total ampere-hours life per pound of lead, but if "equivalent complete discharges" be taken to mean complete 8-hour rate discharges, the average life of positive plates under proper treatment should be about 1000 such 8-hour discharges.

Hugh Rodman.

L 4. What should be the loss in capacity of a storage battery kept in first-class condition, after (a) twelve months' use, (b) two years', (c) three years'?

In a properly-constructed battery there will be no loss of capacity until about 95 per cent of the total life of the plate in ampere-hours has been obtained. It is obvious that this point may be reached in two or three years' service or in 10 or 12 years' service, dependent upon the rate at which the battery is used.

Hugh Rodman.

Under ordinary operating conditions, there should be practically no falling off in capacity over the entire period abovementioned.

Hugh Lesley.

L 5. What experience have you had with the tray-plate style of storage batteries, and what are its advantages?

The tray-plate storage battery has the advantage of low internal resistance and absence of all connectors. Its disadvantages, however, are numerous. It can not be inspected; it is very difficult to keep in running condition, and so forth. Such batteries have never been seriously considered by large battery manufacturers.

Hugh Rodman.

L 6. A 500-kw generator (550-volt) is sufficient to pull the street-railway load, except for a period of two hours per day when we have a peak load of 300 amperes above machine capacity. What is the general procedure in calculating for a storage battery and booster outfit to take care of this peak? Give size of battery and booster, explain function of each, and show how you arrive at results.

The size of battery for L 6 depends not only upon the excess peak but also upon the violence of the fluctuations. A properly-constructed battery and booster will absorb this latter as well as take care of the excess peak, assuming that the 300 amperes given is continued through the two hours. The size of battery required will be one capable of discharging at 300 amperes for two hours, or, say, one having a three-hour rate of 240 amperes and one-hour rate of 480 amperes. This battery will also absorb some fluctuations, say 1000 amperes. The number of cells is obtained by dividing the line voltage, 550, by the "floating" voltage of a single cell, 2.06, or 218 cells. The booster for such a battery must be capable of furnishing current equal to the total battery current, with voltage sufficient to equalize the maximum drop of the discharging battery, which in this case will be the number of cells, 218, multiplied by the difference between the floating voltage, 2.06, and the completely discharged voltage, 1.7, or 78 volts.

Variations from this simple calculation will occur with each individual installation.

Hugh Rodman.

The data given in this question are not sufficiently complete to permit of a specific answer. It is not stated whether the 300-ampere excess above the machine capacity refers to the average load or to the momentary maximum fluctuations. If it refers to the average load it will be necessary to know the extent of the momentary fluctuations above this average. If it refers to the momentary maximum it will be necessary to know whether or not the battery must carry any portion of the average load, and if so what this amounts to in ampere-hours. Furthermore, if the average load for the two hours specified is greater than the machine capacity, so that the battery must take a portion of this average, the general shape of the average peak should be given. For example, such a peak would not usually be rectangular, jumping suddenly to a point of 300 amperes above the machine capacity, remaining there for a period of two hours and then as suddenly dropping off. It would rather rise gradually during the two hours to some sustained maximum, after which it would as gradually fall off, producing a peak more or less triangular in shape, upon which would be superimposed the momentary fluctuations.

Having determined the general character of the peak to be handled by the battery as above, the capacity of the battery would be determined from the capacity curves and other data too extensive for publication here.

The booster is a dynamo, usually motor-driven, whose armature is connected in series with the battery and whose function it is to control the battery output. In order to charge a battery, the voltage applied to its terminals must be increased. In order to compel it to discharge, the voltage of the circuit to which it is connected must be reduced. If the 'bus voltage remains constant, this variation in the voltage at the terminals of the battery must be brought about by some special controlling apparatus, which in railway regulation is provided in the form of the booster. The momentary charge and discharge of the battery, to care for the momentary fluctuations of the load, is made automatic by automatic control of the booster field. For controlling the slower changes of load and causing the battery to take a net continuous charge or discharge, while regulating the momentary fluctuations automatically, hand control of the booster field is also provided. The armature capacity of the booster must be the same as the output to be taken from the battery in amperes.

The voltage of the booster will depend upon the discharge rate of the battery, the extent of which is to be subjected to the continuous peak discharge, the number of cells and the 'bus voltage.

J. Lester Woodbridge.

L 7. Explain tests for electrolyte of storage battery.

A test of the specific gravity is one of the most important to make and should be watched very closely. This should be taken with a hydrometer. The two most injurious substances for storage-battery work are chlorine and iron. Nitrogen, copper and arsenic are also considered injurious, although not to the same extent. The following are probably the most convenient tests for these substances:

Chlorine: Dilute a small portion of the electrolyte with twice its quantity of distilled water, add two or three drops of chemically pure nitric acid (HNO_3), heat in a test tube, cool and add a few drops of nitrate of silver ($AgNO_3$). The presence of chlorine will be noted by a white, cloudy appearance, which will often amount to a white precipitate if much chlorine is present. This is a very delicate test, and should the solution show much coloration the electrolyte should not be used.

Iron: To a small quantity of the diluted electrolyte add a few drops of nitric acid (HNO_3), and heat. When cold add a few drops of solution of potassium sulphocyanide (KCNS). The presence of iron will be shown by a deep red color.

Nitric Acid and Nitrates: Dissolve a little brucia (this is more often found in the form of brucine) in pure concentrated sulphuric acid (H_2SO_4), to which it gives a faint rose tint. Pour this into a small quantity of the electrolyte. If nitric acid or nitrates are present the solution will immediately become a magnificent red. This color, on standing, passes into a reddish yellow. This is undoubtedly the best test for nitric acid and nitrates, as the fact that the solution has been used does not affect the reaction at all.

Copper: Ammonia solution added to the electrolyte produces a bluish white precipitate if there is any copper present. When an excess of ammonia is added, so that the liquid becomes alkaline, the precipitate disappears and the liquid becomes a dark-blue color.

Arsenic: Pass sulphide of hydrogen through warm solution of electrolyte. If a yellow precipitate forms, it is probably arsenic, but may be sulphur, caused by oxidation of H_2S. Take two test tubes, put a portion of the whole liquid in each. Add to one ammonium sulphide and to the other ammonium carbonate. If the yellow precipitate is an arsenic compound, it will be dissolved by the ammonium sulphide, but not by the ammonium carbonate.

The above are considered the main impurities found in electrolyte, and if these are absent the electrolyte is undoubtedly safe to use, although several other tests are sometimes given by different authorities. The impurities that these other tests show, however, occur so seldom that they are not worth considering.

George L. Bixby.

Electrolyte tests are made very carefully by the battery companies in installing batteries, practically no impurities being allowed. In service cells are usually tested for iron and chlorine by the following methods:

For iron: By adding to test tube one-quarter filled with electrolyte, a few drops of nitric acid, heating, then an excess of ammonia. Iron is shown by light flocculent precipitate.

For chlorine: By adding to a test tube one-quarter filled with electrolyte, water to nearly fill the tube and then a few drops of sulphur nitrate solution. Chlorine is shown by heavy white precipitate.

Where either of these tests show impurities, a sample of the electrolyte, about one quart, should be sent to the storage-battery manufacturers for careful analysis.

Hugh Rodman.

Electrolyte should consist of pure sulphuric acid and water, and for ordinary purposes the hydrometer test is the only one that need be taken. The gravity at the end of discharge depends upon the number of ampere-hours taken out and upon the proportional amount of electrolyte to amount of plates, and varies with the different types and sizes of cells. It is important that not only should the acid be pure, but that the water used to dilute the acid and also used to replace evaporation loss should be of satisfactory purity. If distilled water is not obtainable for the purpose, only water of known purity should be used. There are many substances in both water and acid that are especially injurious, and among the principal dangerous impurities are chlorine, iron and nitrates. It is best, where any impurities are suspected, to send a sample of acid or water to the maker of the battery to determine whether it is satisfactory for use.

Bruce Ford.

L 8. Who makes a good, cheap still for making about three gallons of water per day?

L 9. What is the best way of calibrating small 0 to 3-volt meter used in testing cells?

By means of standard instrument, which can usually be found in any small town.

Hugh Rodman.

When a voltmeter gets out of adjustment it is usually due to a bent needle, and this may be caused by connecting the voltmeter to a higher voltage than it is intended for, which will cause the needle to make a violent swing and become bent when it strikes the stop. In such a case, it is only necessary to bend the needle so that with no current it will register zero on the scale. If the permanent magnets in the meter become changed in strength, it will be necessary to recalibrate the meter by means of an alteration in the adjusting resistance in series with the effort coil of the voltmeter. If the pivots or jewels of the meter are injured, it is an instrument maker's job to repair them. Most meters are supplied with a seal, which has to be broken in order to get into the working parts, and it is best to return the meter to the maker for any repairs or adjustments.

Bruce Ford.

M—SWITCHBOARDS, INSTRUMENTS AND STATION WIRING

M 1. Do the advantages of installing switching apparatus in a separate building justify the use of this type of construction in a moderate-sized central station?

No.

H. H. Barnes.

I think it would not be well to do this to the extent that is carried out in large plants. I believe it is well to isolate switching apparatus from the rest of the plant as much as possible.

F. C. Sargent.

We should not think that the advantages gained in installing switching apparatus in a separate building would justify the use of this type in a moderate-sized station. This, of course, would vary according to circumstances and local conditions.

M. C. Turpin.

Separate buildings for switchboard apparatus will not generally be necessary except in central stations of largest size.

Geo. Ross Green.

M 2. Should transformers, switchboards and apparatus be placed in groups indicating the kind of service they perform—street service, commercial, multiple service, and so forth—or should they be placed, say, all switchboards in one group and transformers separately, so as to facilitate the work of the substation attendant, giving him a chance to look over the total service at one glance? In which case is the wiring simplest?

Try to keep the switchboard panels together, and arrange the rest of the apparatus to suit individual cases.

H. H. Barnes.

Latter plan preferable.

P. C. Oscanyan.

M 3. Which material is preferable for building high-tension racks and switchboards—wood or iron?

Iron, by all means, with ample spacing and line insulators as supports.

H. H. Barnes.

Iron. The writer believes in using bare wire, for the reason that if bare wire is used with proper insulating supports the liability from trouble is just as much at a minimum as it would be with insulated wire, so far as electric effect is concerned. With reference to safety, the writer believes that an operator knowing a wire is bare and has a high tension will leave it alone, whereas if it is insulated he is likely to take chances with it, thus risking the possibility of causing serious damage not only to himself, but to apparatus.

F. C. Sargent.

Iron is preferable, for the following reasons: An iron structure is more rigid and dependable for reasons of strength. It has a far greater resistance toward unforeseen strains and shocks. It is fireproof, which is the strongest argument in its favor. A thorough insulation and grounding is required whether the use of iron or wood is contemplated, for wood can not be counted upon as an insulator for high voltages. The possibilities of a thorough grounding from a mechanical and electrical standpoint are much better in the case of an iron structure. High-tension practice, say 5000 to 20,000 volts, commands a thorough and independent grounding of all the parts of the high-tension equipment, *i. e.*, current and potential transformers, switches, compensators, and last, but not least, racks of any kind. Iron racks are also favorable to the use of steel pins.

Wm. Lederer.

Iron is best for high-tension racks, as all construction around a high-tension switchboard should be fireproof. Insulators should have a large factor of safety for voltage carried.

H. C. Stoddard.

Iron; for safety of attendant and prevention of fire.

B. E. Morrow.

Use fireproof material.

J. F. Dostal.

Iron is preferable. On the boards for controlling high-tension work only low-tension wires from transformers are brought to the board; and in the case of racks, the insulators should be sufficiently strong to withstand the strain between the wires and the frame.

M. C. Turpin.

M 4. Is it preferable to use bare copper wire for inside wiring on high-tension transmission work, and, if so, why?

Yes. There is great liability of some one assuming the insulation to be sufficient to prevent injury from a shock.

J. S. Reesman.

Bare copper wire should be used for inside wiring on high-tension transmission work, but wiring should be protected by barriers or be at such a height from the floor as to be difficult of access. It is very difficult to insulate high-tension wires, particularly those above 34,000 volts, sufficiently to prevent accidents in case of accidental contact.

H. C. Stoddard.

High-tension interior wiring should be insulated with fireproof material.

John McFeeley.

Bare copper wire is decidedly preferable, for the reason that all high-tension work should be so installed as to require no handling, and if it were insulated an attendant would be likely to place confidence in the insulation, which might be faulty, whereas if the bare wire is visible he is much more unlikely to come in contact with it voluntarily.

M. C. Turpin.

M 5. Should barriers be used in preference to large clearances? How does first cost of installing barriers compare with first cost of constructing the larger building required by the larger clearances?

Large clearances are preferable in most cases and are cheaper in plants located where real estate and buildings are cheap. A combination of moderate clearance and barriers is advisable for most plants. Local conditions should determine each particular case.

H. C. Stoddard.

M 6. Modern switchboard practice seems to exclude every kind of automatic circuit-opening device between generators and 'bus-bars. Why is this done?

The exclusion of automatic circuit-opening devices between generators and 'bus-bars, the writer believes, is important for the continuous operation of the plant, because an automatic device is not always to be relied on; that is, it will sometimes operate for no apparent reason, and at other times will fail to operate when wanted, and devices of this kind used on generators, especially in parallel operation, would cause serious trouble. The writer, with ten years' experience in several plants with apparatus and switchboards, has never seen a case wherein an automatic device between generators and 'bus-bars would have been of any use, but if used would have been detrimental to the successful operation of the plants. I think it is not necessary to equip with knife switches between 'bus-bars and oil switches in moderate-sized plants.

F. C. Sargent.

Automatic switches should be located in the feeder lines, but not between generators and 'buses, so that a short-circuit will open the feeder line where the trouble is but will not trip generator switches, as when several generators are operated in parallel tripping a circuit-breaker on one would throw more load on the other generators and probably cause their circuit-breakers to go out also.

H. C. Stoddard.

Omission of automatic circuit-opening devices between generators is generally to secure continuity of service by disconnecting an overloaded or grounded circuit with the least possible disturbance to the rest of the system. That is, avoid shutting down any feeders or part of system except that actually necessary to clear trouble.

F. C. Clark.

If the cable from the generator is carefully inspected and tested before installation and run in iron pipe, there is very little danger of trouble in this short distance. Another breaker on the machines adds apparatus that may give trouble, is likely to be neglected and needs inspection.

John McFeeley.

Alternators can not give sufficient current on short-circuit to cause them to burn out within a limited time, therefore nothing is gained by protecting them with automatic circuit-opening devices.

P. M. Lincoln.

Automatic circuit-opening devices are placed in feeders because 99 per cent of the trouble will occur on them and thus only the circuit affected is opened. Otherwise, the generator circuit is opened, thus throwing out of service all the remaining feeders and necessitating the generator being thrown into service again; all of which consumes an appreciable length of time.

M. C. Turpin.

By doing away with the automatic switches on generators and using the relays for merely indicating trouble on machines, thus trusting to the operator to see that generators are not damaged, many vexatious delays are avoided. Generators are built to stand momentary short-circuits without damage. If any automatic devices are used on generators they should act only after a comparatively long time interval. With the development of reliable relays, the generators will doubtless be provided with safety devices in the future.

Geo. Ross Green.

I assume that this question is intended to apply more particularly to alternating-current apparatus, from the fact that this is the case with direct-current, constant-potential apparatus.

It is the exception rather than the rule that the output of alternating-current generators is not divided beyond the 'bus-bars into several circuits, each controlling but a fraction of the total generator load. It is customary to install in each of these circuits some form of automatic circuit-opening device. If no such device were installed on the entire system and a short-circuit were to occur on any part of the system, with a properly designed generator the sudden excessive flow of current incident to the short-circuit would kill the generator field, and the whole system would quit business without injurious effect to the generator. Now, supposing an automatic circuit-opening device were installed between the 'bus-bars and the generator and the same short-circuit were effected, the automatic breaker would open with the same result. The investment made necessary by the automatic device has gained nothing. "But," you say, "why not install both circuit automatics and generator automatics," and again, what's the use? A short-circuit might occur on one circuit and the generator automatic might trip at the same time. With a poorly-designed and a poorly-insulated generator they would be desirable, but it is better insurance against interrupted service to put the additional investment into the generator and circuit-breakers in the different circuits.

Chas. B. Burleigh.

With automatic switches between the 'bus-bars and generators, an abnormal overload might immediately disconnect one generator. This would overload the others and they would be automatically disconnected, probably killing the 'bus-bars entirely. Modern generators are now built so that they will stand heavy overloads or even short-circuits for a period that is usually long enough to locate the trouble. The feeder that is short-circuited can be switched off, which relieves the generators. Would recommend automatic switches in feeders and a reverse-current indicator in the generator leads.

J. F. Dostal.

M 7. Should oil switches, provided with automatic circuit-breakers connecting individual lighting and power feeders to a common 'bus-bar of a 2300-volt alternating-current distribution system, be equipped with disconnecting switches, so as to provide a ready means for examination and repair of the oil switch without disturbing the rest of the feeders?

Yes.

B. E. Morrow.

It is usual to provide all oil switches with disconnecting switches so that oil switches can be cut out of circuit and repaired at any time.

P. M. Lincoln.

It is most desirable to have such switches.

M. C. Turpin.

In all large installations a disconnecting switch should be used.

Geo. Ross Green.

M 8. What is the relative cost of brick and concrete for switchboard compartments?

Considering the use of pressed but unglazed brick in construction of high-tension switch compartments and 'buses, the relative cost is about two to one in favor of concrete.

B. G. Jamieson.

M 9. Give opinion of the merits of ordinary separate-well switchboard-type oil switches for use on high-tension transmission lines on rotaries.

The oil switch is universally conceded to be the best type for modern high-tension work. A separate well for each pole is supplied to the better types of oil switches. There is no question about its desirability on high-tension work.

P. M. Lincoln.

Oil switches should be capable of breaking short-circuit capacity of generators connected.

P. C. Oscanyan.

M 10. In wiring from generator to switchboard for 2-phase work, is it better to use a conduit for each phase or to put all four wires in a single conduit?

If clay or wood conduit, use conduit for each phase.

H. Clyde Parrish.

With any kind of conduit excepting iron I should put each phase in a separate duct. With iron conduits I should put all four wires in a single duct.

F. C. Sargent.

Other conditions being equal, it would be better to use one conduit for each phase.

M. C. Turpin.

M 11. With 2300-volt, 3-phase, 60-cycle generators, which is considered the best practice for connecting the generator with the switchboard—three-conductor lead-covered cables; three-conductor rubber-covered cables in conduit; three separate rubber-covered cables in one conduit, or three single-conductor lead-covered cables bunched together? There is not room to run single-conductor cables, each in its own conduit. The space under the floor where the cables run has more or less water in it during spring freshets. Explain Murry loop method.

Use three single-conductor lead-covered cables bunched together.

H. Clyde Parrish.

Three-conductor lead-covered cable.

F. C. Sargent.

Three-conductor lead-covered cable is the best practice; but cable should be tested with a large factor of safety for voltage used, should have ample ampere-carrying capacity and should be provided with "bells" at the ends to widen the lead sheath. Bells should be filled with an asphaltum insulating compound or so-called "coil-filler."

H. C. Stoddard.

Generally up to plants of the largest size, lead-covered, 3-conductor cable will be found sufficient. Where there is water the cables should always be lead-covered.

Geo. Ross Green.

M 12. In a small station of about 600-kilowatt capacity, 60-cycle, 3-phase, for mixed power and lighting load, is the use of three ammeters on generator panels, instead of one, worth the difference in cost? The power feeder panels are fitted with three ammeters; the lighting feeders, single-phase, with one each.

I should recommend using three ammeters, as it is the only method of quickly and accurately telling whether or not your load is balanced. This is certainly worth the difference in cost, but I should only have one ammeter on the power-feeder panels.

F. C. Sargent.

Modern practice seems to favor the use of one ammeter with ammeter jacks so that the same ammeter can be put in any phase.

P. M. Lincoln.

Most assuredly. Otherwise, there would be no method of telling whether the three phases of the machine were balanced or not.

M. C. Turpin.

M 13. Which is better to install on alternating-current light and power feeders of 2300 volts—instantaneous or time-element circuit-breakers?

On modern types of switchboards, time-element circuit-breakers are used.

H. Clyde Parrish.

Time-element circuit-breakers.

J. S. Reesman.

We have both in use; but I prefer the time-element circuit-breaker, for the reason that any instantaneous short-circuit or trouble on lines which does not amount to anything does not open the circuit with a time-element breaker, whereas it does with the instantaneous. It is also possible with the time-element breaker to burn a circuit clear of trouble.

F. C. Sargent.

Time-element circuit-breakers are usually preferable on 2300-volt alternating-current circuits for light and power where the circuit carries a relatively small part of the 'bus energy. A circuit usually supplies a considerable area, and service should be maintained if possible. If time-element devices are used, the line in case of grounding may burn itself clear and allow the district between the station and the burnout to still be supplied. Time-element circuit-breakers also allow continuous service for peak overloads of short duration where instantaneous ones would interrupt it. If the energy transmitted by the circuit is a relatively large part of the station's output, instantaneous opening devices may be desirable in order not to disturb the system as a whole.

F. C. Clark.

Instantaneous circuit-breakers are entirely satisfactory, provided they are set sufficiently high not to open unless there is a "short" or extremely heavy overload.

M. C. Turpin.

All depends on the system as a whole. If the switch controlling the circuit is the last of a series beginning at the generating station, no time-element breakers should be used.

Geo. Ross Green.

Time-element circuit-breakers where the time is adjustable would certainly be preferable to instantaneous breakers.

W. A. Carter.

M 14. Are power-factor indicators used with single-phase machines supplying 125-cycle circuits?

Power-factor meters are not manufactured for 125-cycle circuits, for the reason that practically no power is supplied at this frequency and consequently no demand has been made for them. The frequency is now obsolete, or nearly so, consequently no power-factor meters are used.

M. C. Turpin.

There is practically no call for power-factor meters, either single-phase or polyphase, on 125-cycle circuits. The 125-cycle generating outfit is practically obsolete.

P. M. Lincoln.

M 15. Describe connections and action of the frequency indicator?

In a frequency indicator there are two coils at right angles to each other, in series with one of which is inductance and with the other resistance. At the centre of the coils, and free to revolve, is a small iron bar under the influence of the fields of both coils. The reactance of the coil containing inductance will vary with change of frequency, changing its field strength, the field of the coil containing resistance remaining constant, so the small iron bar, being under the influence of the field of both coils, will change its position with change of field strength of one coil due to change of frequency.

B. J. Denman.

In general: In the commercial measurements of electrical quantities, that of current is the only one in which the measurement is directly referred to the quantity in question. In an ammeter the effect produced by the current is directly the means of indication. For measurement of potential it is necessary to refer to the current that will flow in a circuit of known resistance. A possible exception to this may be found in the spark-gap method of potential measurements. In the measurement of frequency we are dealing with the cycle changes of another quantity, that of potential, and as usually the changes occur too rapidly to be observed directly by a potential-measuring device, it is also necessary to resort here to an indirect method of observation. Instruments now in commercial use operate on one or the other of the following principles, namely: the sensitiveness of a vibrating reed to respond to an operating force of the same frequency only, and the change in impedance produced in inductive circuits by change of frequency. Instruments of the first type usually consist of a number of steel reeds tuned to various pitches over a certain range of vibration. The reeds are placed within the attractive influence of a magnet that is energized by a potential the frequency of which it is desired to obtain. The general construction of an instrument of this type is comparatively simple, as it has no moving parts on pivots or bearings. To obtain the best results, it is necessary that the potential be maintained at a value that does not differ greatly from that for which the instrument has been designed, as with too low a value the amplitude of vibrations will not be sufficient to be readily observed. With too high a value a number of reeds differing in pitch from that of the circuit may start into vibration, with varying amplitude as they come into and out of synchronism with the magnetic field. In view of this, and from the fact that at the best the readings are largely a matter of estimation, this type of meter has not come into very extended use in this country.

A simple instrument of the second type would consist of an ammeter connected in circuit with an impedance of known value and across a circuit of known potential. From the current reading obtained and the known value of potential and impedance, the frequency may be obtained by calculation. To make the instrument direct-reading, it would be necessary to maintain the potential at some fixed value or to introduce some compensating device in the instrument—the latter principle being the one employed in most instruments now in commercial use. The construction in general consists of an operating element in series with an inductive resistance and a retarding or compensating element in series with a non-inductive resistance. No controlling spring is used, the retarding element taking its place. If the torque of the operating and the retarding element varies in the same ratio with the changes of voltage, the instrument will give indications that are independent of changes of voltage.

The chief causes that would produce variation of reading with change of voltage are:

First—Increase of non-inductive resistance, due to heating on high voltages.

Second—Change of permeability of iron in inductive resistance with change of current.

Third—Dissimilarity of ratio between torque and voltage of operating and retarding elements.

The first may be minimized by keeping the heating effect of the current low and using a wire of a low temperature coefficient. The second will always be present to a greater or less extent, but it may be corrected by combining it with the third in such proportion that the two will cancel out.

The general construction of the instrument may be such that it will harmonize in appearance and method of reading with those of other instruments that may be used in the same installation, and from the manufacturers' standpoint it possesses the advantage of using parts that are interchangeable with other instruments, such as voltmeters and ammeters.

P. MacGahan.

M 16. What method is used in testing for grounds with a millivoltmeter? How is result determined?

A millivoltmeter for use in testing grounds must be used in connection with a resistance sufficiently high to prevent damage to the instrument, even though the full line voltage is across the instrument and resistance in series. Connections should be such that the current passing through the insulation or fault to be determined passes also through the instrument and resistance. The total voltage across the instrument with its resistance and the ground, *i. e.,* the line voltage, should also be taken. The resistance of the ground is calculated by the following formula: $R = \frac{(V - 1)}{V^1} r$, where V is the line voltage used in making the test, V^1 the reading of the voltmeter in series with the fault, r the resistance of the voltmeter and resistance in series, and R the resistance of the fault under measurement.

C. E. Skinner.

M 17. Is it advisable to tie-in Edison underground feeders solid at the station end or should they be fused? All mains are fused at junction boxes.

M 18. Describe any successful commercial installation of mercury-arc rectifiers used as lightning arresters.

So far as the writer is aware, mercury-arc rectifiers have never been commercially used as lightning arresters.

P. M. Lincoln.

M 19. Give best method of regulating voltage on distributing end of high-tension transmission line carrying both railway and lighting load.

Place automatic feeder-regulators in the lines.

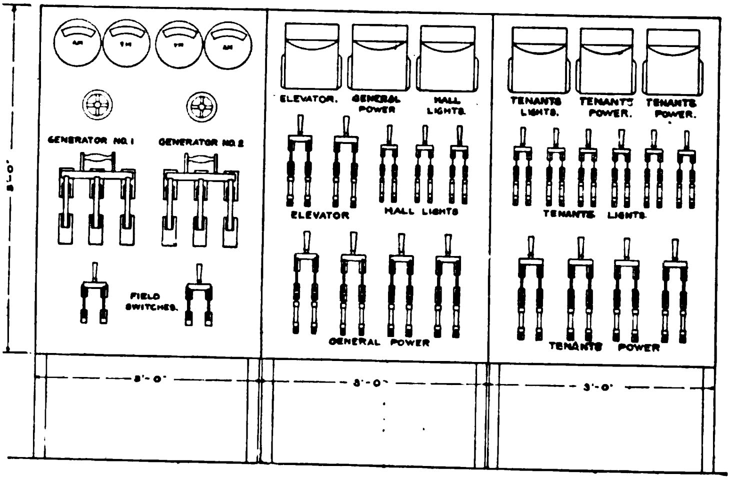
M. C. Turpin.

There is a considerable number of voltage regulators that can be used for regulating transmission-line voltage. One that has been suggested, which I consider a most excellent plan, is to use a synchronous motor at the substation having its field controlled by a Tirrill regulator. The reaction of the synchronous motor on the line, if its capacity be large enough, will give a perfect voltage regulation at the substation independent of the voltage variations that may occur on the transmission line. The range of regulation can be increased, if necessary, by putting a reactance between the transmission line and the substation, so that all the current coming from the transmission line passes through the reactances.

P. M. Lincoln.

M 20. What is the best arrangement of switchboard for plant of, say, 160-kw capacity, with two machines, and where the distribution of different circuits for the office building are to be on same board?

The accompanying sketch shows an arrangement of switches



SWITCHBOARD ARRANGEMENT

and meters for generators and distributing circuits of a 110-volt system for lights and small power for an office building.

G. M. Armbrust.

Would suggest one panel, either of slate or marble, to control the two generators and one panel to control the feeder switches of as many circuits as desired. Switches to be arranged so that the generators could be run in multiple or on separate 'buses if so desired; the feeder switches made double-throw so as to be used on either machine, and a tie-switch between the 'bus-bar, would enable running the machines in parallel.

M. C. Turpin.

M 21. What has been the experience of central stations or power plants with regard to cables between generators and switchboard for alternating-current, low-potential (500 volts or under) and large currents, say from 100 amperes up? (a) With duplex or three-wire cables in lead sheath? (b) Rubber-covered single-conductor cables? (c) Single-conductor cables with other insulation than rubber? (d) Have there been any known cases of trouble due to abrasion of insulation by drawing cables b and c through conduits? (e) Have there been any cases of trouble due to moisture? (f) Have there been any cases of fire?

M 22. In the case of a three-phase switchboard, what is the practice with regard to (a) mounting one or three ammeters on the generator and feeder panels; (b) two or three indicating wattmeters on the generator panels; (c) using a power-factor indicator to take the place of the indicating wattmeters?

The writer recommends (a) three ammeters on generator panel; (b) one polyphase indicating wattmeter on generator panel.

F. C. Sargent.

(a) One ammeter with ammeter jacks seems to be the most desirable combination. (b) A single polyphase indicating wattmeter has many advantages that neither of the proposed alternatives has.

P. M. Lincoln.

The general practice is: (a) mount three ammeters on the generator and feeder panels; (b) two indicating wattmeters on the generator panels; (c) it is not a satisfactory scheme to use power-factor indicator in order to determine amount of power delivered over any circuit, for the reason that this would necessitate a calculation by the engineer, which, of course, is not desirable, as he would usually desire to tell this at a glance.

M. C. Turpin.

M 23. What is the status of the alternating-current reverse relay?

The present standing of this apparatus is fully described in the *Electric Journal,* August, 1906. This form of relay has been in successful operation at some of the largest power plants in the country, and has been giving the absolute satisfaction that the designers anticipated.

P. MacGahan.

M 24. Why does the National Electrical Code allow molding to be used for electric wires but condemn a wire touching wood anywhere else?

It is considered as being a conduit for the wires and can only be used on outside of walls.

J. S. Reesman.

I do not believe any one can give a good, logical answer to this question, as it is one of the numerous inconsistencies in the *National Electrical Code.*

F. C. Sargent.

If molding has at least two coats of waterproof paint or is impregnated with a moisture repellant, and is properly made according to the requirements of the Underwriters, there is practically no danger from this source, whereas if wires are touching wood which has not had this treatment and wires lie open, there is more or less liability of fire or accident.

C. A. Hutchings.

M 25. Is it advisable to attempt to insulate a switchboard gallery?

I think it is very unwise to attempt to insulate a switchboard gallery, particularly in a station constructed of steel and concrete. It is impossible to be sure that a gallery can be kept free from grounds. It is also difficult to insulate such a structure for 2000 volts, and I do not see how any one can depend on such insulation to prevent accidents. It is certainly much safer to have all structural work about the power station thoroughly grounded and all apparatus grounded also, such as frames of generators, transformers and other devices.

J. T. Whittlesey.

N—BELTS AND SHAFTING

N 1. What has been the general experience in actual measurement of static and running friction in the average industrial plants, such as textile mills, and so forth? In very modern installations I

have found it largely in excess of allowances usually made by engineering authorities and the tables of the machinery dealers.

The result of many years' experience leads me to agree most heartily with this statement. Engineering authorities and machinery dealers seldom if ever calculate on the use of poor lubricant, misaligned shafting, settling of buildings and foundations, stiff belts, poorly-aligned belts, poorly-balanced pulleys, improperly-pitched gears, and a thousand and one items many of which are in most cases present.

Chas. B. Burleigh.

N 2. From a vertical hydraulic turbine, where floor space is no object, is it better to run a quarter-twist belt to a horizontal line of shafting and belt this shaft to the generator, or to use a bevel gear and pinion to drive the horizontal shaft?

Bevel gear is less likely to interrupt service and costs less to maintain.

The Union Elec. Co.

Use bevel gear and pinion.

H. Clyde Parrish.

A quarter-twist belt is only suitable for small installations where a small belt is used and only a small amount of power transmitted. For 50 horse-power or more it would probably be better to use bevel gear and pinion.

H. C. Stoddard.

N 3. What is the correct shape for oil rings on brass bearings 3.75 by 15 inches?

N 4. Should the oil grooves in bearings run from rings to centre and end of bearing?

Nearly to centre and to end.

J. A. Lane.

Yes.

H. Clyde Parrish.

N 5. What can be done to insure against hot boxes on machines?

Heating of boxes is caused by weight of pull on shaft, lack of lubrication, and improper quality of lubricant. Bearings sometimes heat because boxes are not long enough to give proper bearing surface. Large shafts sometimes cause heating because rim speed is too great for bearing. In case of heating, feeding more oil, changing the kind of oil, feeding cylinder oil, putting a spoonful of graphite in oil, dropping small pieces of soap in the bearing, or putting a little salt or powdered sulphur in the bearing, will often afford relief. Sulphur is not a lubricant, but a little powdered sulphur seems to smooth up the babbitt and give it a glaze on the surface which aids in getting a hot box into shape. In extreme heating, waste or burlap sacks dipped in water and put on outside of bearing will frequently aid. Do not use any more water than necessary, particularly around electrical machinery, and never put water inside a bearing. If heating is caused by faulty design in shaft or bearings, try to get the trouble remedied. If by lack of oil, arrange the oil-feed so as to secure a constant supply and also catch all drips to be filtered and used again. Sometimes bearings have a hole in bottom caused by a flaw in casting, and oil is running out as fast as it can be put in. Sometimes ring oiling bearings have no communication between the two reservoirs so that oil may be carried up by one oil ring and runs along top of shaft to other reservoir, so one reservoir is always empty and the other always full. The remedy is to connect the bottom of two reservoirs with a piece of quarter-inch pipe. In case of hot bearing never shut down entirely until bearing is cool enough not to stick. In many cases it is not necessary to shut down.

H. C. Stoddard.

Use plenty of clean oil, of good quality.

B. E. Morrow.

O—OIL AND WASTE

O 1. What are the maximum and minimum limits that good practice dictates for the amount of cylinder oil, of engine oil, and of waste, that may be used per unit in a plant of 500-kw units, 1000-kw units, and 1500-kw units? All direct-connected, condensing-engine generator sets.

O 2. Give a simple test or series of tests that may be applied without an extensive laboratory to determine a good cylinder oil and a good engine or dynamo oil.

A good oil should have the following properties for either engine or cylinder:

1. Body enough to prevent the surfaces to which applied from coming into contact (viscosity).
2. Freedom from corrosive acids.
3. As fluid as possible with required body.
4. Minimum coefficient of friction, embodying several properties.
5. High flash and burning points.
6. Freedom from elements liable to produce oxidation or gumming.

The following series of tests can be applied without an extensive laboratory, and will determine a good oil or bad oil if properly carried out:

1. Proper viscosity is without doubt the most important qualification of a good oil, and with a careful viscosity test a good oil will not be rejected nor a poor oil accepted. Viscosity is closely related to the density of an oil. The simplest means of testing the viscosity of an oil is to determine the time of flow of a certain volume of oil through a small orifice as compared with time of flow of same volume of a good oil or of water; the substances compared to be tested at same temperatures and preferably at the temperature to which the oil is to be subjected. A cylindrical vessel (copper or glass preferred) with an orifice in the bottom about one-sixteenth-inch or less in diameter should be used. Record the time required for the oil to flow through the orifice and then for a like volume of water or a standard oil. Where large quantities of oil are used would recommend the purchase of a viscosimeter, several types of which are in the market. The following viscosities of oil as compared with water have been determined by accurate tests: Prime lard oil, 3.6; sperm oil, 2.2; castor oil, 2.6; rapeseed, 4.2. Temperature during test, 68 degrees Fahrenheit.
2. To identify an animal oil or a vegetable oil, chlorine turns animal oil brown and vegetable oil white.
3. Flash and burning test: Place sample of oil in a small dish having a tight cover through which a thermometer can be

inserted. Make a small hole in cover to allow vapors to escape as oil is heated. Heat the vessel slowly through a layer of sand, gently increasing the heat. When the oil is hot, pass a lighted match or flame over the hole in the cover of the vessel, observing the temperature. The temperature at which oil flashes is the flash point. The burning point is obtained by continuing the heating, and last temperature observed at time oil takes fire is burning point.

4. To test for gumming and oxidation, compare time required for a small amount of oil to flow down a smooth inclined plane with the time required for a like amount of good oil to flow down the plane.

5. Density. Simplest method without use of instrument is to find the loss of weight of same body in oil and in pure water. Ratio of the loss will be the density as compared with water. The following densities have been determined by experiment:

Kind of Oil	Density
Animal	0.62 to 0.89
Sperm at 39° F.	0.88
Rapeseed	0.91
Cottonseed	0.92

K. W. Alger.

Refer to *Oil Analysis,* by A. H. Gill, published by J. B. Lippincott Company. Detailed answer too long to give in *Question Box.*

C. E. Skinner.

O 3. Explain test for determining viscosity of machine lubricating oil.

See answer to O 2.

K. W. Alger.

O 4. In a lubricating oil, what is the relation of viscosity to the value of the oil as a lubricant?

See answer to O 2.

C. E. Skinner.

O 5. In lubricating an engine cylinder is there any economy effected in feeding a smaller drop at more frequent intervals? If so, has it been successfully accomplished?

P—OVERHEAD LINES

P 1. Have creosoted poles been used to any extent, and have they proven as good as other poles?

Creosoted poles have not been used to any extent for electric-light work where the voltage is 1100 or over. They are better than ordinary poles so far as long life is concerned, but not in any other respect.

A. T. Lloyd.

I have used creosoted yellow-pine poles, sawed to an octagonal cross-section, rather generally for underground distributing poles and to a slight extent for line poles. The creosoted poles used for underground distributing poles have proven better than chestnut, by reason of their longer life. The creosoted line poles have not been as satisfactory as chestnut poles, for the reason that they are not so strong as live chestnut; we have found them much more liable to snap off or buckle.

John J. Gaffney.

P 2. Foreign practice having shown that the life of poles can be materially increased by proper impregnation, why is not this method more generally used in this country?

Although it is true that both foreign and American practice have shown that the life of poles can be greatly lengthened by impregnation with proper antiseptics, several factors have tended to retard the general adoption of the methods, even though their economy has been fully demonstrated. It is only within the last few years that the rapidly increasing price of structural timber and the difficulty of obtaining an adequate supply at any price have brought about a realization of the danger of a serious shortage. The high cost of preservatives and labor in this country, in proportion to the prices for untreated timber that formerly prevailed, made frequent renewals more profitable than preservative treatment. The uncertainty of economic conditions, trade competition, and the desire to obtain the largest possible dividends, have also prevented the consumers of poles and similar timbers from making a large present investment that will bring in no returns for several years or until the end of the natural life of the timbers. It is significant that railroad systems, electrical and mining companies, and other large users of structural timbers, have now realized that the artificial preservation of their timber is an economic necessity and an extensive development of the industry may undoubtedly be expected in the next few years.

Wm. L. Hall, Chief Forest Service.

The comparatively small use of creosoted poles in this country is, I think, due to the fact that almost unlimited amounts of good, live chestnut poles can be obtained at small cost, supplying a much cheaper pole than the treated pine pole. There are, moreover, comparatively few plants in this country that are equipped for creosoting poles longer than 30 or 35 feet.

John J. Gaffney.

P 8. How much can the life of poles be prolonged by the best method of impregnation?

Just what increase in length of service will be brought about by the open-tank or brush treatment can not be definitely stated, as all the work under American conditions has been too recent to permit the decay of the poles. It is well known that a thorough impregnation with a good grade of creosote will render wood immune to decay for a long term of years, and judging from the condition of the butts of the poles after treatment by the open-tank process, and from our knowledge of the antiseptic qualities of the preservative, there can be little doubt as to the securing of a decided increase in life. It can be said without hesitation that this increase will be more than sufficient to repay the cost of the treatment.

Wm. L. Hall, Chief Forest Service.

Some information regarding this and the two following questions will be found in a paper published by the United States Department of Agriculture, entitled, *Prolonging the Life of Telephone Poles*, by Henry Grinnell, assistant forest inspector, of the Forest Service. This paper can be obtained free of charge by addressing the United States Department of Agriculture, Division of Publications, and asking for Separate No. 395, Year Book 1905.

E. J. Fowler.

It is uncertain how much the life of a pole can be prolonged by the best method of impregnation, which is probably that of creosote oil. The life of a pole thus treated is certainly at least two or three times that of an untreated pole.

John J. Gaffney.

P 4. If by means of impregnation the life of a pole can be doubled, what percentage of increase in the price of the pole, due to the treatment, can be considered a good investment?

In considering what increase in the present cost of a pole is justified in order to secure an increase in life, say, of 100 per cent, it is necessary to take into consideration the cost of replacement, of transportation, and other expenses for renewal, which the preservative treatment eliminates, as well as the probable rise in price of pole timber. Just how much all these will amount to must depend on too many varying conditions to permit of a definite answer for all species. However, if the charges for transportation and setting are included in the first cost of pole, there is little reason why the increase in cost for preservation should not be in proportion to the increased life that the treatment will secure.

Wm. L. Hall, Chief Forest Service.

From 50 to 75 per cent.

John J. Gaffney.

See answer to P 3

E. J. Fowler.

P 5. What results have been obtained in the treatment of poles to prevent decay at the top of the ground?

After the poles have become air-dry the following treatment is recommended:

The butts of the poles are placed in an open iron tank containing a sufficient amount of creosote (dead oil of coal tar) to cover them to about one foot above the ground line. The tank should be equipped with steam coils, or so arranged that fire can be placed underneath. The temperature of the oil should then be raised to about 212 to 225 degrees Fahrenheit, and for most species this temperature should be maintained for about six hours. The heat should then be shut off and the poles allowed to stand for several hours in the cooling oil. The process can be somewhat hastened by allowing the hot oil to run out and letting in the cold oil simultaneously. The practicability of this method has been fully demonstrated by the experiments of the Forest Service. Many details, however, yet remain to be worked out in order to arrive at the quickest and most economical method.

A cheaper but less effective treatment can be given by painting the butts of the poles with two coats of creosote, or of carbolineum, applied at about 175 degrees Fahrenheit. The results of the open-tank process, however, are much more desirable in proportion to the first cost.

The open-tank process has been found particularly well adapted for such species as southern yellow pine, chestnut, cedar, lodge-pole pine (the so-called "white pine" or "bird-eye pine" of the Rocky mountains) and western yellow pine. One of its principal advantages is that it avoids the necessity of creosoting the entire pole, while in most situations only that portion at or near the ground line is subject to rapid decay. However, in very damp, warm situations, such as are found along the Gulf coast, it is often necessary to creosote the entire pole.

Wm. L. Hall, Chief Forest Service.

See answer to P 3

E. J. Fowler.

We have had no experience with treating poles for, say, 10 feet from the butt, to prevent decay at the ground line. I understand that successful results have been obtained by painting poles with pitch for a distance of 10 feet from the butt.

John J. Gaffney.

P 6. Have any serious accidents, due to greater liability to ground, occurred with creosoted poles?

Have never heard of any serious accidents on creosoted poles due to greater liability to ground.

John J. Gaffney.

P 7. Is there any objection to the use of creosoted poles in a small plant of about 400-kw capacity, operating twenty-four-hour

service, when primary feeders are protected by line switches so that current can be cut off of any section of line when doing repair work?

Creosoted poles should not be used, on account of their greater conductivity. It will not always be advisable to cut off primary for small repair work, and little can be done with live wires on a creosoted pole.

A. T. Lloyd.

I do not think the expense warrants the use of creosoted poles, but I see no serious objections to using them if you consider them worth the excess in cost.

F. C. Sargent.

P 8. What would be the average age of chestnut trees from which can be cut poles of the dimensions given in these specifications?

Length Over All in Feet	Minimum Circumference Six Feet from Base	Minimum Circumference Top
30	**37 inches**	**22 inches**
35	**41 "**	**22 "**
40	**44 "**	**22 "**
45	**47 "**	**22 "**
50	**50 "**	**22 "**
55	**53 "**	**22 "**
60	**57 "**	**22 "**

The age of chestnut corresponding to the specifications you quote varies with a number of factors, such as site, origin, composition of stand, and so forth. The following, however, may be considered an approximate average for chestnut grown in Maryland:

Minimum Circumference Six Feet from Base	Corresponding Ages	
	Trees from Seed	Coppice
37 inches	53 years	43 years
41 "	58 "	48 "
44 "	63 "	54 "
47 "	68 "	59 "
50 "	73 "	65 "
53 "	78 "	72 "
57 "	84 "	79 "

The taper as great as that called for in the specifications does not occur except in abnormal conditions. The average top circumference of poles corresponding to the above classes would vary between 25 to 30 inches.

Wm. L. Hall, Chief Forest Service.

Length	Base	Top	Years
30 feet	37 inches	22 inches	30 to 35 years
35 "	41 "	22 "	35 " 40 "
40 "	44 "	22 "	40 " 45 "
45 "	47 "	22 "	45 " 50 "
50 "	50 "	22 "	50 " 55 "
55 "	53 "	22 "	55 " 60 "
60 "	57 "	22 "	60 " 65 "
65 "	57 "	22 "	65 " 70 "

John J. Gaffney.

P 9. Do the usual specifications given for butt and top dimensions of chestnut poles (see question No. 8) agree with the natural dimensions of the tree?

See answer to P 8.

Wm. L. Hall, Chief Forest Service.

Generally speaking, no. Tree that will give required butt will generally be larger at top than the specification requires.

P. C. Oscanyan.

P 10. Should native western poles be cut when sap is up or when sap is down?

The poles should, if possible, be cut in the winter or early spring, both because the physiological condition of the sap at that season of the year is such as to offer least encouragement to the development of wood-destroying fungi, and in order that they may have the full benefit of the dry weather of the late spring and summer for seasoning.

Wm. L. Hall, Chief Forest Service.

When sap is down.

J. A. Lane.

Native western poles should be cut when the sap is up, thereby prolonging the life of the pole. The process of decay will not begin so soon.

E. A. Taylor.

P 11. Please give your experience in the use of cypress poles, particularly cypress grown on high, dry ground.

The results given by cypress poles vary widely with the conditions under which the timber is grown. The swamps along the Gulf coast are the best localities for the species, and cypress grown in such situations is among the most durable of American woods. When it grows on the higher lands along the northern boundaries of its range, the wood is decidedly less durable, and is otherwise inferior to that of many well-known commercial species. Its chief objection for use as poles lies in the tendency of the sap-wood to strip off from the hardwood, rendering the pole difficult and dangerous to climb. For this reason it is rejected by many of the large construction companies for all work that requires frequent climbing of the poles.

Wm. L. Hall, Chief Forest Service.

P 12. Locust cross-arm pins being scarce and hard to get, what is taking their place?

Birch and oak; also steel pins.

H. Clyde Parrish.

Steel or iron pins with wooden cobs.

The Edison Elec. Illg. Co., West Chester, Pa.

In the tropics we have discarded the wooden pins on account of short life and use native wood for poles and cross-arms, with Beardsley galvanized-iron pins secured to the arm by the bolt that passes through the arm and screws into the iron part of pin that takes the insulator. This is much stronger than any wooden pin, and as only an eleven-sixteenths-inch hole is bored in the arm, the arm is also much stronger.

For poles we use jiqui wood, a hard, heavy wood that does not rot at the surface of the ground as do cedar, chestnut and other woods. For cross-arms, jucaro and acauo, which are about a third heavier than a yellow-pine arm of the same size.

F. V. D.

Black birch.

J. F. Dostal.

P 13. Should pole-line hardware, such as bolts, coach screws, washers, cross-arm braces, anchor or ground rods, and so forth, be galvanized by the electrolytic process or by the hot-galvanized, or dipping, process?

Pole-line hardware galvanized by the hot process has given us the best satisfaction.

H. B. Gear.

By the hot-galvanizing or dipping process.

H. Clyde Parrish.

Most engineers demand that articles when galvanized meet with what they call "four-immersion test," and to accomplish this the hot-galvanizing or dipping process must be used. This method does not leave the coating as clean and smooth as the electrolytic process, but the coating is heavier, therefore, no doubt, is the best for such articles as anchor rods, cross-arm braces, washers, and so forth. The electrolytic process will stand only a two-immersion test, but I believe it is best on such articles as bolts, lag screws, and so forth, for the reason that the coating is left clean and smooth, while with the other process spelter is left on the thread, which will be broken off when the nut is screwed on the bolt, and destroys the galvanizing feature of the threaded part of the bolt.

J. S. Reesman.

Any metal used for outside work should be galvanized or tinned by hot or dipping process. The electrolytic process is defective in not properly covering pinholes or other defects in the surface, and these imperfections will soon be attacked by the weather.

C. R. Meston.

All the hardware we use on our construction work is galvanized, and it seems to us that the hot-galvanized, or dipping, process is much more durable than the electrolytic process.

F. C. Sargent.

Regarding galvanizing of such articles as contain threads, like nuts, bolts and turnbuckles, where snug fit is required, my experience has been that the electrolytic process is better, as in the employment of the hot process for this kind of work it is necessary to run over the bolt with a die, or in the case of the nut to retap. This, of itself, would remove the galvanizing done by the hot process, but the electrolytic process deposits a coating only a few thousandths of an inch thick, which, however, is ample for protection against the elements. For this reason we find it preferable. In the case of coach or wood screws the hot process is better, as it gives us a heavy coating. The hot process would likewise apply better to washers, cross-arm braces, and anchor or ground rods, from the fact of the zinc being thicker.

H. Frederic Frasse.

P 14. In a transmission of moderate capacity, does the security against damage by lightning afforded by guard wires offset the expense and the liability of short-circuiting by fallen guards?

Most transmission lines give better satisfaction without the use of overhead ground wires.

H. Clyde Parrish.

Yes.

B. J. Denman.

We have had more trouble with guard wires than they were worth.

The Edison Elec. Illg. Co., West Chester, Pa.

Opinions vary very widely in regard to security afforded by overhead grounded wire. In any event, if such a wire be installed there is no reason why it can not be installed in such a manner as to practically insure that it shall not come down and short-circuit the line.

P. M. Lincoln.

P 15. Do general results show that barbed wire over transmission line is really any protection against lightning?

Yes.

B. J. Denman.

We could not see that barbed wire afforded protection when used over Edison 3-wire line.

The Edison Elec. Illg. Co., West Chester, Pa.

P 16. What distance apart should lightning arresters be placed on 2300-volt lines in order to obtain the best protection?

Half the value of lightning arresters depends on the ground connection. We find that arresters placed at all points where transformers or motors are connected, with a ground wire on water pipe or copper plate in permanently moist earth, give the best satisfaction.

H. Clyde Parrish.

I do not think there is a set rule governing placing of lightning arresters. I think it is better to place them near the ends of the circuits, also in localities where the lines are lowest with reference to the sea level. From observation it seems to me that severe storms usually follow in the same locality, and the placing of lightning arresters is really a matter of local conditions, which should be carefully studied. In one place with which the writer is connected there are 330 miles of streets covered with power and house-lighting circuits, and we have no lightning arresters on the lines at all, excepting the station arresters. To my knowledge, we have not lost over two transformers in six years from lightning.

F. C. Sargent.

The protection will increase with the number of arresters.

The Edison Elec. Illg. Co., West Chester, Pa.

P 17. In what parts of a transmission line having considerable difference in altitude do you find the most serious effects from lightning discharges?

In the valleys.

P. C. Oscanyan.

P 18. Has any one any data on difference of potential between different parts of a transmission line, due to differences in altitude?

P 19. Are there any objections to putting high-tension wires (2300 volts) in lead sheaths for overhead work? If so, what are they?

A few years ago suit was instituted against our company for $20,000 damages, the action being brought on the charge that the wires in question did not have the proper insulation. Several men were at work repairing the side of a frame building and in order to do so they worked from the top of a small extension having thereon a tin roof. Running diagonally across, seven feet above this roof, was a pair of wires, 2400 volts, carrying current to transformers which furnished light to this building. One man (the plaintiff) admitted on the witness stand that he saw the lights burning in this particular building and thought the wires above the extension were the source of supply. Yet very often he would run his hand along the wires to show his fellow workmen they were harmless. One wet morning he got caught. After staying in the hospital about six months he was discharged, having lost four fingers, part of a foot, and his hearing. The plaintiff produced many New York expert electricians to testify that if lead-sheathed cable had been used the accident would not have occurred; on cross-examination they all agreed that the lead-sheathed would be the most dangerous (to human life) for the following reasons: If a lineman, who had worked on this cable at any place to where it extended, in making a tap or joint had been careless in letting the lead sheathing touch the conductor, or a boy with a gun had shot through the cable making circuit between the conductor and lead, then the cable would be a *safe* death trap. Our wire was three-braid weatherproof, and it was proven that no insulation was absolutely safe (to human life). The judge granted a non-suit, stating that the company had shown that the three-braid weatherproof wire was the standard wire used in this country for overhead electric distribution and that lead-sheathed cable would be more dangerous to life from the fact that the lead covering, while containing some merits, may become "alive" at any minute. All electric wires carrying current, alive or dead, are dangerous.

W. W. Titzell.

The objection to using lead-covered cable for overhead work is the weight, cost, and care necessary in making taps. Modern pole-line construction has reached a point when 2300-volt wires, properly put up, give very little trouble.

H. C. Stoddard.

The prohibiting objection is the expense.

B. E. Morrow.

P 20. Considering cost and difficulty in making good joints, does aluminum show any advantage over copper for high-tension, long-distance transmission?

The cost of making joints in aluminum conductors on long-distance, high-tension transmission lines averages about 0.2 per cent of the cost of the conductor. The saving in the original investment varies between 50 and 100 times the cost of making the joints.

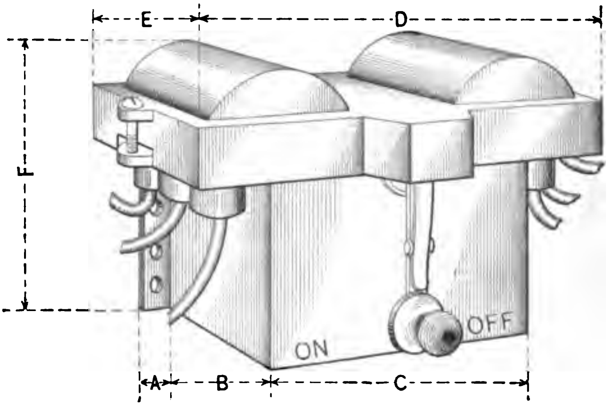
William Hoopes.

The Condor Water and Power Company, Tolo, Oregon, has 100 miles of 20,000-volt transmission line using No. 1 seven-strand aluminum wire that has been in operation for over two years, and had no breaks or trouble with this wire. Joints are made with the aluminum sleeve twisted with two monkey-wrenches, and the joint can be made as quickly as with copper wire of the same size. The aluminum wire costs less than copper of the same carrying capacity and is lighter, making less strain on the poles.

H. C. Stoddard.

P 21. Is there a line fuse-box made that is suitable for installation on a pole and will safely stand the blowing of larger than 30-ampere fuses on short-circuit on 2200-volt line?

We use a pole oil switch for cutting-off a short-circuit. We believe it is not a good practice to put fuses in 2200-volt



Pole Oil Switch for Cutting off Short-Circuit main lines, and if oil switches are used on the main line the line can be cut up into sections in case of trouble. Sketch herewith shows switch we have used with good results.

W. E. Holmes.

The General Electric Company makes a line cutout box, catalogue No. 5696, rated at 100 amperes at 2500 volts. This box has an expulsion-type fuse block taking an aluminum fuse. Though some failures have been noted, the operation of the box has, on the whole, been successful.

H. L. W., C. E. I. Co.

The writer has used iron fuse block No. 5696, manufactured by the General Electric Company, at its full capacity of 100 amperes at 2300 volts on outside pole lines and has had no trouble with same. Fuses have blown promptly without damage to fuse block.

H. C. Stoddard.

P 22. Is it advisable to use patent screw anchors in preference to using a "deadman" for anchoring guy wires in electric light and power pole lines? What has been the practical experience with the former, especially in localities where the soil is adapted to their use?

Yes, where the lines are not very heavy. Under ordinary conditions the screw anchor would be just as effective and far cheaper.

N. Read.

In street-lighting work, screw anchors are satisfactory where ground will permit.

E. A. Taylor.

P 23. (a) What method is employed in dead-ending heavy wires carrying current at 2300 volts? If strain insulators are used, describe them. (b) Ditto for 6600 volts.

We dead-end the 2300-volt heavy cables with a double Brooklyn strain insulator fastened to a through bolt in double arm.

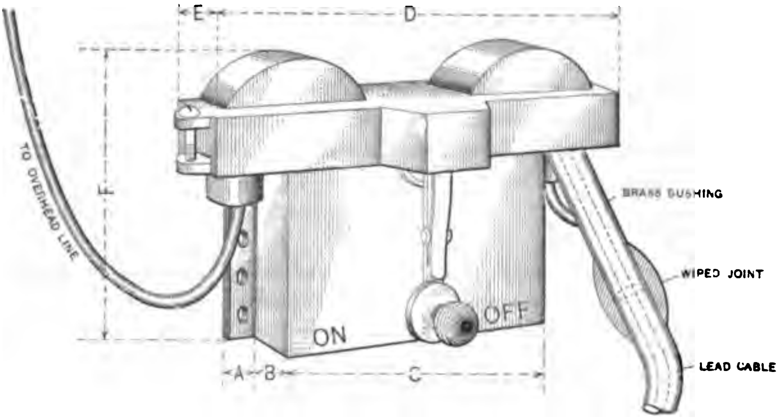
John J. Gaffney.

In dead-ending lines as large as No. 0000 copper, we use a double arm and two insulators. We use strain insulators, but do not favor them.

N. Read.

P 24. Describe method of connecting underground services at 2300 volts to overhead lines. If terminal box is used for end of underground cable, give sketch or description.

I use an oil switch with brass terminals into which the lead cable can be threaded and the conductor attached to lug inside the box, the other terminals being connected to the overhead lines. See sketch.



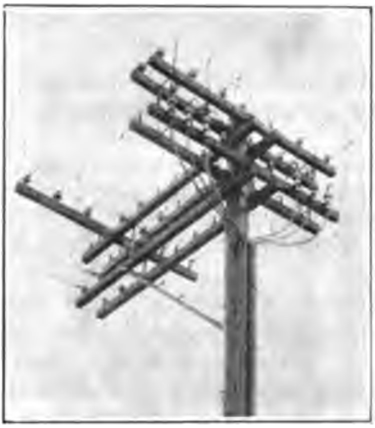
Oil Switch and Connections

W. E. Holmes.

Connection between underground and overhead lines may be made through either subway or overhead cutout boxes, consisting, in either case, of cast-iron boxes 6 × 10 inches to 8 × 12 inches, lined with porcelain or other insulating material carrying fuse clips for enclosed fuses or solid-link connectors. Cables should enter these boxes through water-tight bushings and door made water-tight by use of rubber gaskets. Inadvisable to use such cutouts in manholes not connected to drainage system. Except for the smaller-size taps, cutouts described have not proven entirely satisfactory and have in some cases been replaced to a considerable extent by a form of porcelain pothead (G. and W.) within which the cables are joined through male and female slip tubes into which are "sweated" the respective lugs of the cables to be joined. This joint, and the insulating compound surrounding same, is protected from the weather by a porcelain petticoat which slips down over the pothead when the connecting lugs (slip tubes) are joined together.

F. S. Chandler.

The safest and least expensive method of connecting underground services to overhead lines consists in the use of a porcelain sleeve installed as a pot-head at the junction of the cable and the overhead wire. This sleeve can be maintained on a cross-arm near the top of the pipe so as to leave but a short length of cable exposed outside the pipe and the rubber-covered weatherproof wire run from the top of the pot-head to the overhead line. This pot-head requires no box, as it is weatherproof and will occupy a minimum amount of space on the pole.



POLE AND CROSS-ARMS

H. B. Gear.

P 25. Do you solder all joints in overhead lines?

Joints on overhead lines should always be soldered.

H. Clyde Parrish.
J. S. Reesman.
J. H. Enright.
F. C. Sargent.
M. C. Turpin.
W. M. Scott.

We solder all joints, to reduce line loss and to increase the mechanical strength of the connection.

A. T. Lloyd.

All joints on copper lines should be soldered except when hard-drawn copper is used. In that case it is advisable to use some form of joint, such as McIntire, to avoid interfering with the temper of the wire.

With aluminum conductors, it is necessary to use some sort of mechanical joint, as soldering of aluminum is not practicable.

H. H. Barnes, Jr.

It is customary to solder all joints in overhead distribution wires. All series wires should have soldered joints.

E. A. Taylor.

Certainly. The solder protects the joint and increases carrying capacity.

N. Read.

P 26. What is the smallest wire you use on overhead lines?

Number six B. and S. gauge.

W. W. Titzell.
M. C. Turpin.

Number eight.

H. Clyde Parrish.
W. M. Scott.

Number ten.

J. H. Enright.

No. 6 B. and S. gauge, which I think is the smallest that should be used in any construction for the sake of mechanical strength.

F. C. Sargent.
John J. Gaffney.

For lines exposed to snow or sleet it is advisable not to use a smaller copper wire than No. 6 B. and S. With aluminum, No. 3 B. and S. should be taken as the lowest limit, in which case it is preferable to use a stranded conductor.

H. H. Barnes, Jr.

No. 6 copper. If No. 8 were used the spans would have to be shortened and the increase in the cost of poles would overbalance the decrease in wire cost.

N. Read.

Smaller wire than No. 8 hard-drawn is unsafe.

The Edison Elec. Illg. Co., West Chester, Pa.

P 27. Has it been found practicable and profitable to revarnish insulation of overhead wires in position, for the purpose of preventing deterioration? If so, what coating was used and how was it applied?

The writer does not believe this is practical or profitable.

F. C. Sargent.

P 28. What precautions should be used when tapping or repairing wires carrying 2000 volts?

Shut off the current, if possible.

H. Clyde Parrish.

Put rubber gloves on a lineman who knows his business.

W. W. Titzell.

Doing the work in fairly dry weather, using rubber gloves and ordinary precautions.

F. C. Sargent.

We have only very careful men do this work, and see that they use rubber gloves.

John J. Gaffney.

When working "hot" use rubber gloves and be sure that the workman is not in contact with any other wires, also that the pole is dry. In short, be *careful.*

N. Read.

Keep clear of other wires and grounds.

W. M. Scott.

P 29. Why has direct-current, high-tension transmission been practically neglected in the United States?

Because of the difficulty in obtaining direct current at high voltage, on account of the commutation troubles.

M. C. Turpin.

An alternating-current system has a lower first cost, a lower rate of depreciation, is less expensive to operate, has a higher efficiency and greater simplicity, than a direct-current system. For very long transmission lines the harmful influence of large inductance and charging current weighs heavily against the many advantages, and it becomes a question which system is the better.

John Cyrus Distler.

P 30. What are the advantages of the Y over the delta connection? Grounded and ungrounded neutral.

If transformer or armature windings are delta-connected the pressure across the terminals of one phase is the same as that of the circuit to which they are connected, but in the case of a star connection, each winding furnishes only 58 per cent of the line or 'bus pressure. The current in one leg of a delta winding is 58 per cent of the line current, while in a star system each leg carries the full line current. On account of the above pressure relation, much smaller transformers may be used for a given line voltage when connected in star than if connected delta. Less insulation is required with grounded neutral than when left ungrounded or when delta connection is employed, pressure to ground being 58 per cent of phase pressures. If the neutral is grounded there is less shock on connected apparatus if the transmission line becomes grounded.

Where three transformers are connected in delta and one burns out, it may be disconnected, and 3-phase current at line pressure may be obtained from the other two on open delta or Y connection. Where the neutral is grounded on both ends 3-phase current could be obtained from two of them, but it would be at only 58 per cent of the normal voltage between phases in a star-connected system.

F. C. Clark.

When using the Y system, voltage can be increased 1.73 times with the consequent saving in copper.

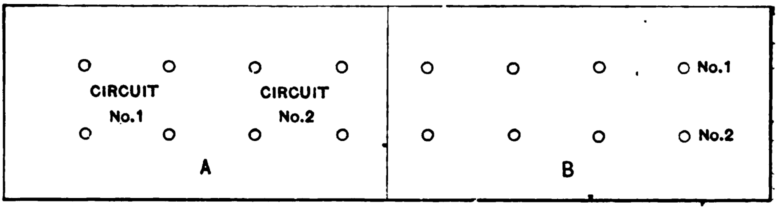
M. C. Turpin.

With transformers Y-connected the voltage on each primary coil is one-third or 57.7 per cent of the line e.m.f. For high-potential transmission this allows smaller transformers to be used and the installation is subjected, normally, to only 57.7 per cent of the voltage. However, the size of the wire must be increased in the same ratio. Now, in small transformers, where the insulation occupies a large proportion of the volume of the coil and where the wire is rather delicate because of its small cross-section, the requirements of the units of the Y will give a more satisfactory and rugged construction. These advantages are not marked in large transformers, which are usually connected in delta.

The big advantage of the delta connection lies in the fact that if one coil breaks down the voltage relations are not disturbed and the transformer will continue to operate satisfactorily although the power rating will be reduced from three to two. On the other hand, if one coil breaks down in the Y connection almost the entire system is disabled. However, if the neutral is grounded operation will be possible in many cases. Grounding of neutral, too, limits the maximum voltage between high-tension coils and core, between high and low-tension coils, and between line and ground.

John Cyrus Distler.

P 31. Which is the better way to construct two circuits, 2-phase, 4-wire, on one pole, diagram A or B, using two 4-pin cross-arms?



Connect as in diagram *A*.

J. A. Lane.

According to diagram *A*, since the two phases of each feeder can be placed at the diagonals of the square, thus making them mutually non-inductive. The two feeders may be made mutually non-inductive by proper transposition, or the induction between them may be reduced by increasing the distance between the pole pins *b* and *a'*, similarly between *a* and *b'* on lower arm.

H. L. W., C. E. I. Co.

I should use construction as per diagram *B*.

F. C. Sargent.

Diagram *A* would be the better way, as it eliminates inductive action between the circuits, provided the two wires of each phase are diagonally opposite. To obtain the same result with arrangement *B* it would be necessary to transpose the wires at intervals.

G. M. Armbrust.

I consider the arrangement shown in *A* preferable, for the reason that repairs can be carried on on one circuit when the other is alive without so much danger and that the *A* condition gives more compact arrangement of the wires, thereby somewhat reducing inductive effects.

P. M. Lincoln.

The arrangement shown in diagram *A* is preferable to that shown in diagram *B*, as mutual induction between circuits 1 and

2 is less to be feared with the former arrangement. That is to say, sudden load-variations on one circuit are less likely to affect the voltage of the other.

H. H. Barnes, Jr.

If it is desired to have the least self-induction possible, circuits should be arranged as in diagram *A*. Operating conditions, however, may make *B* preferable.

Geo. Ross Green.

If this refers to best arrangement to prevent inductive interaction, diagram *B* probably allows transpositions to be made more easily. With either arrangement without proper transpositions there will be an unbalanced inductive action which will unbalance the system, especially in long lines.

B. J. Denman.

P 32. In line work how far apart should alternating-current wires be placed to get best results? Answer is desired in the form of a table (suitable for practical purposes) covering all standard voltages, current frequencies and power-factors.

Publication No. 7001 of the Westinghouse Electric and Manufacturing Company, entitled *Drop in Alternating-Current Lines*, gives such a table and a chart for use in connection with same. The values given are for 60 cycles only, but since they are directly proportional to the frequency, they can be readily computed for any desired frequency.

H. L. W., C. E. I. Co.

Would advise span of 48 to 60 inches between 23,000-volt wires.

H. C. Stoddard.

See *Electric Journal,* or *American Electrician,* articles by Ralph D. Mershon. *Electric Journal,* March, 1907, p. 137.

Geo. Ross Green.

P 33. What attention in the design of high-tension systems may eliminate the phenomenon of resonance?

To avoid resonance, the shape of the wave should be as near as possible to a sine. In addition to this, the length of the transmission line should differ radically from that of a quarter-wave length at the frequency at which the line is operating.

Trouble from resonance, however, has thus far not been very real in practice.

H. H. Barnes, Jr.

There are at least three points of consideration: Wave-form, the relation of capacity to inductance, and the connection of transformers.

Use, as nearly as possible, a simple sine-wave. All other forms are the resultant of upper harmonics superimposed upon the fundamental sine-wave. Conditions for resonance occur when $2 \pi f L = \frac{1}{2 \pi f c}$ or $LC = \frac{1}{(2 \pi f)^2}$ where L = inductance of the circuit, C = capacity and f = frequency of either the fundamental or of the upper harmonics that happen to be present. Hence the pure sine-wave will give but one value to f, while a complex wave will give many, depending on its shape.

Proportion the inductance and capacity so that their product will not satisfy the last equation with any of the possible values of f.

Suppose transformers on the transmission line be connected *Y*. Now, if one of the primary coils be cut out, then the corresponding secondary coil that is in series with one leg of the line acts only to add its inductance. As the added inductance is considerable, if the capacity of the line be large a very bad case of resonance might result. Connecting *delta* will avoid this danger.

John Cyrus Distler.

P 34. (a) Can a telephone line be successfully operated on same poles with 18,000-volt transmission lines at 60 cycles? (b) If so, what should be the space between transmission lines and telephone lines? (c) If open line, how often transposed?

We use cross-arms which we standardize ourselves on all voltages up to 3000 volts. The distance between pole-pins is 30 inches, adjacent pins, 12 inches. Have operated a telephone line successfully on a 13,000-volt transmission line at 60 cycles, telephone line being about 7 feet from the nearest high-tension wire.

F. C. Sargent.

Eight feet, and transpose every 500 feet.

John J. Gaffney.

(a) Yes, undoubtedly.

(b) As far away as possible, but not within less than four feet.

(c) It would be advisable to transpose the telephone line every 500 feet at least. On a long transmission line, it would also be necessary to transpose the power conductors to avoid interference with the telephone system through electrostatic induction.

H. H. Barnes, Jr.

(a) Yes. (b) Eight feet. (c) Every four or five spans.

W. M. Scott.

P 35. On telephone lines running on the same towers or poles with high-potential transmission lines, has any difference been noted between the use of copper or iron for the telephone line; referring particularly to electrical conditions and not to mechanical strength of lines?

No.

W. M. Scott.

P 36. Has it been found satisfactory to operate distributing systems 3-phase, star-connected with the neutral grounded, in order to save cost on long lines and to get a higher voltage for transmission and still be able to use standard transformers?

It has been found entirely satisfactory in Chicago, Cincinnati, and a number of other large cities, to operate distributing systems star-connected with neutral grounded. Some extra precautions are necessary in operating these lines, on account of the grounded neutral, but these disadvantages are greatly outweighed by the advantages of the transmission at high voltages.

H. B. Gear.

Such systems are satisfactory when small, as balance can be readily taken care of, but become unwieldy as they grow.

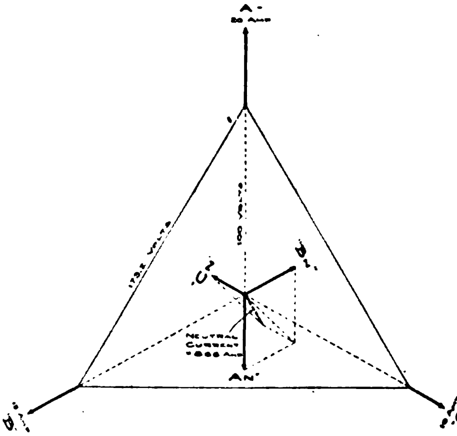
H. L. W., C. E. I. Co.

Yes.

W. M. Scott.

P 37. In case of a 4-wire, 3-phase circuit, 100 volts between any phase and the neutral and 173.2 volts between any two of the phase wires, if an unbalanced load is carried (for instance, if there is 20 amperes on A phase and 15 amperes on B phase and 10 amperes on C phase), does the neutral take care of all the return, or do the less heavily loaded phase wires as B and C take care of part of the excess from A?

The accompanying diagram will indicate an easy method of determining the neutral current under the above-mentioned conditions with a unity power-factor. The current vectors of 20 amperes, 15 amperes and 10 amperes are laid off to scale in phases *A, B* and *C,* respectively. If the load is connected from phase to ground (in star) the phase values of the current will appear in the neutral as the vector *An, Bn* and *Cn.* The resultant of the three vectors as determined and indicated graphically by the dotted lines is the neutral current of 8.66 amperes. The neutral in a 3-phase, 4-wire circuit will carry the total current in all three phases combined vectorially. The resultant current vector is commonly termed the "unbalanced" current of the 3-phase circuit.



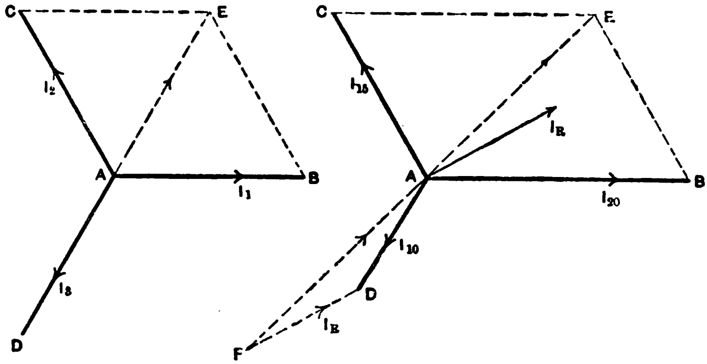
W. R. McCann.

The less heavily loaded phase wires will not give any assistance. With the phase current as assumed in the question, the return current in the neutral will amount to approximately 8.7 amperes.

H. H. Barnes, Jr.

The neutral carries the vector sum of the current in the three phases. For balanced conditions this would be zero since *AE*, the vector sum of *AC* and *AB* (*i. e.*, $I + I_2$), is equal and opposite to *AD* (*i. e.*, I_3), hence the sum of *AE* and *AD* is zero.

For unbalanced legs with equal power-factors and current values as given in question, lay off to scale *AB* = 20 amperes, *AC* = 15 amperes and *AD* = 10 amperes; and let $\angle BAC = \angle CAD = \angle DAB =$ 120 degrees. *AE* is the resultant of *AC* and *AB*. Prolong *EA* to *F*, where *FA* = *AE*. Then *FD* is the resultant of *AE* and *AD*. Scaling *FD* we find the current in the neutral is 8.7 amperes. Drawing through *A* a line parallel to *FD* we have its phase position, which is approximately 30 degrees ahead of *AB*. The current in main No. 1 is 20 amperes, in No. 2 it is 15 amperes, in No. 3 it is 10 amperes and in the neutral it is 8.7 amperes.



John Cyrus Distler.

The neutral wire takes care of the unbalancing only.

W. A. Carter.

P 38. We have a short line of 50-foot poles. On top we carry our 23,000-volt transmission line, two wires on a 30-inch cross-arm, the third wire on an insulator and pin driven in top of pole. Five feet below this cross-arm are nailed two Western Union brackets, one on each side of pole, which carry our private telephone line. Five feet below this we have four 4-pin cross-arms, 18 inches apart. The

two top arms carry 2300-volt primaries and the two lower arms carry the 110-volt secondaries. Please describe any faults or dangers possible in this construction.

Telephone wires should be lowest of all, since they are mechanically the weakest and most likely to break. If below all others they can not fall across live wires when they do break.

H. L. W., C. E. J. Co.

The telephone line should be below the 2300-volt line.

John J. Gaffney.

As telephone wires are usually small, we should think it very dangerous to have them strung above a 2300-volt primary line.

The Edison Elec. Illg. Co., West Chester, Pa.

None, except danger of high-voltage or telephone wires falling on distributing wires below.

W. M. Scott.

The change I would suggest would be to bring the private telephone line below all other lines. This is the lightest line and the most likely to break; located as described, if it fell it would cause a "short" or ground on your 2300-volt primaries or might cross primaries and secondaries.

N. Read.

P 39. What is the practical maximum limit for distribution with 110-220-volt, 3-wire system, population and distance considered?

Most cities have an ordinance regulating the maximum voltage for overhead distribution, and the practical maximum limit for distribution would depend upon such regulations.

E. A. Taylor.

P 40. What are the respective advantages and disadvantages of the two following plans: (a) Generating and transmitting at 60 cycles, transforming to low tension at substation for distribution. (b) Generating and transmitting at 25 cycles and using motor-generators at substation to transform to 60 cycles, low tension, for distribution?

The advantages of generating and transmitting at 60 cycles rather than 25 cycles with motor-generators are—less substation investment, higher conversion-efficiency, smaller expense for repairs and renewals and, in case synchronous motors are used on the motor-generators, less likelihood of a shutdown at the substation in case of disturbance at some other point on the system.

The advantage of generating at 25 cycles is that in case the 60-cycle load is not large enough during the greater portion of the day to load a generating unit economically, the cost of production will be less from a 25-cycle generating unit producing 60-cycle current through a motor-generator than from a 60-cycle generator.

With a 60-cycle system, as with induction motor-generators or the 25-cycle system, the power-factor is likely to be such that additional capacity in generator windings and transmission cables is required. In the case of long high-voltage transmission, 25 cycles is preferable in many ways.

H. B. Gear.

Unless rotary converters are used, we can not see any advantage whatever in generating at 25 cycles and changing to 60 cycles. Consequently, (a) would seem decidedly the better scheme.

M. C. Turpin.

P 41. What success has been had with horn type of lightning arresters for high-tension lines?

Our 20,000-volt lines have been in operation three years, and although we have some Wurts-type arresters we have never been able to observe a discharge and have had no trouble from lightning.

H. C. Stoddard.

During a recent storm our system received eight heavy strokes of lightning in a period of twenty minutes, any one of which previous to the installation of horn arresters would have caused a shut-down; however, none of the apparatus was injured and there was no interruption. Thus far we have had good results with horn arresters. (See pp. 146, 147, 148.)

A. Balsley.

FIG. 1—DISCHARGE OF SIX GAPS—TWO IN SERIES ON THREE LINES

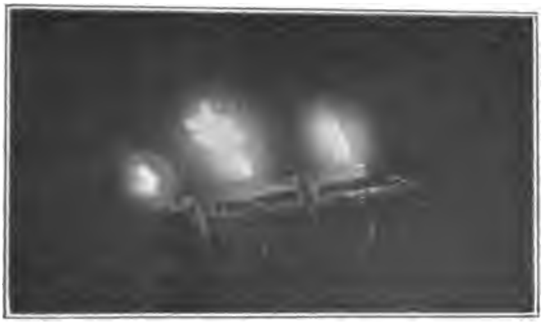


FIG. 2—DISCHARGE OF SINGLE GAPS

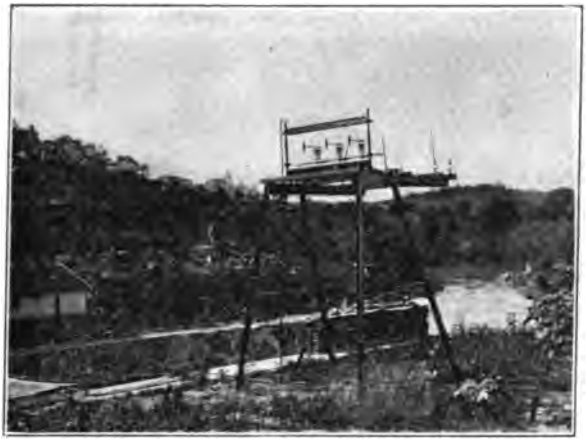


FIG. 3—WATER STREAM, LINE TO GROUND. (THIS DEVICE HAS NOT BEEN IN SERVICE TO ANY EXTENT DURING STORM, AND CAN NOT SAY AS TO ITS MERITS.)

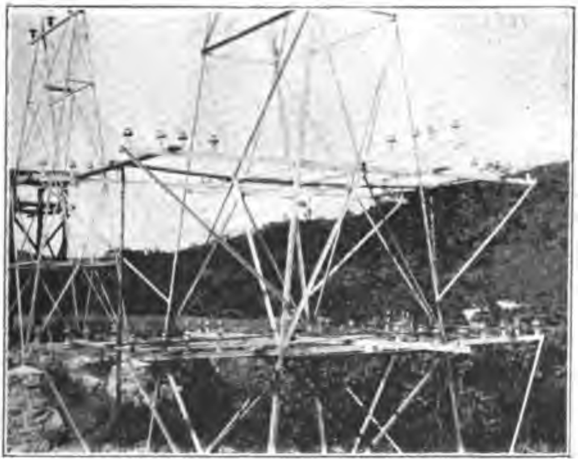


FIG. 4—HORNS MOUNTED ON TRANSMISSION TOWERS

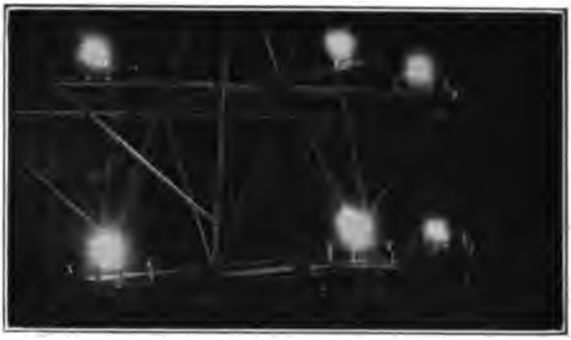


FIG. 5—DISCHARGE OF TWO GAPS IN SERIES—LINES NOS. 10, 11 AND 12

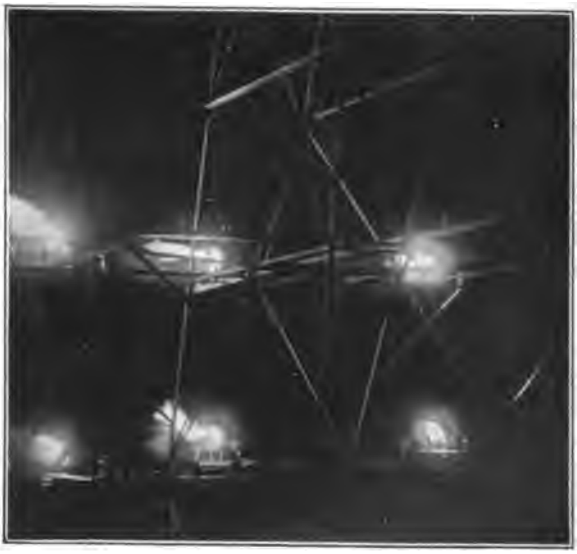


FIG. 6—DISCHARGE OF TWO GAPS IN SERIES—LINES NOS. 7, 8 AND 9

P 42. About a year and a half ago we had some mysterious influences at work which resulted in the burning-out of a number of motors. The station instruments did not record any excessive voltage or amount of current, but within a week there were short-circuits, as above stated, in about a dozen motors located in different parts of the city. The appearance of the insulation of the armatures was as if pricked by a lightning discharge, although the season was in December or January and we were equipped with lightning arresters.

I have been informed that companies using wireless apparatus have paid damages to supply companies on account of injuries to apparatus by high-potential discharges. Have any member companies had similar experience?

The injurious effects of currents employed in radiotelegraphy described in the question are sometimes found when the alternating-current leads supplying the wireless transmitters are not properly protected from the high-frequency, high-potential surgings which have their source in the oscillation circuit. The effects are very much as though lightning discharges had passed into the conductors.

A very effective preventive is the insertion of choke-coils in each power lead, and shunt paths from each lead to earth through a high-voltage condenser of 0.006 to 0.02 microfarad capacity. These shunt paths should be attached between the choke-coils and the wireless transmitter.

Lee de Forest.

The quarterly fire report No. 3, of the electrical bureau of the National Board of Fire Underwriters, makes note as follows of a very interesting and, it would seem, unusual occurrence. We should be glad to learn from our readers if they know of any other such cases.

The report says:

The sending-station apparatus of a wireless-telegraph system was supplied by a 3-kw, 2080-115-volt pole transformer on a 3-phase system. This transformer broke down because of high-voltage reactions caused by the wireless apparatus, and was replaced twice by other 3-kw transformers in parallel, two of which failed. A 7.5-kw transformer was finally installed and operated satisfactorily.

In transmitting signals the secondary voltage (115) was raised to about 20,000 volts, which was impressed on the aerial conductors on the mast. It was found that this equipment when in use produced several breakdowns in lighting and small motor circuits in the neighborhood supplied by other transformers on the same system.

In a doctor's office, diagonally across the street from the wireless station, were incandescent lamps and small motors supplied from a transformer whose secondary line paralleled the secondary leading to the wireless apparatus. The reactions in the system caused by the sending apparatus of the wireless station caused the Edison block fuses in the service entrance-box to be blown violently and destroyed the winding of a small motor. It is reported that these breakdowns were accompanied by flashes of flame about the apparatus in the office. Removing the doctor's line to a position where it no longer paralleled the wireless secondary circuit corrected the trouble in this office. The wireless company also improved the contact of its ground connection, but it does not clearly appear how this had to do with preventing further troubles. One or two other installations in the neighborhood, a closely built-up city block, were affected to a less degree. A number of telephones were rendered useless during the sending of the wireless messages, the code signals being loudly heard in the receivers. This was remedied by the insertion of suitable capacities in the telephone service circuits.—*Electrical World,* October 27, 1906, p. 793.

To the Editors of the Electrical World:

Sirs: The article in your issue of October 27, entitled *Trouble Caused by Wireless Stations,* recalled the experience of the writer, somewhat similar, though different in details.

The station was supplied by an independent alternator giving about ten times the power used in the case cited. Direct current was used for lighting and power purposes in the building, both supplied from a distance, which necessitated the transmission lines parallel to each other and those of several other circuits. Furthermore, the station, being of large capacity, used a wide spread of antennæ, and in its experimental stage was erected irrespective of telegraph, telephone and low-potential alternating currents.

It was a common occurrence at first for fuses to blow in the direct-current circuit, motor-coils were burned out, and the life of incandescent lamps was rendered very short. Telegraph instruments on the line near the station were also burned out, but telephones remained intact. The telephone circuit was of the single-conductor grounded type. A partial remedy for the trouble was found by grounding the lines affected so far as possible through condensers at many points. Low-potential lightning arresters were also used advantageously, and no more serious trouble was experienced. Small fires were started at times by the rush of current following the breakdown of the insulation in lamp sockets or at fuses, but only in one instance was serious trouble caused outside of the building containing the apparatus. This was a fire started on account of very poor insulation and installation of wire in a house using alternating current from a line running near the antennæ. For more than 100 feet away from the station a person could draw static sparks from wires insulated from the ground, but at the distance of 100 feet these sparks had not enough power to be felt. This station used a comparatively long wave, with large capacity and small inductance. When, however, the inductance was increased to any extent, the effect on the neighboring circuits was greatly augmented. These effects were produced partly through direct leakage and ordinary induction from the parallel lines, and partly by induction from the antennæ.

Albany, N. Y. James L. Robinson.

—*Electrical World,* November 10, 1906, p. 925.

P 43. Give fair specification for cedar poles.

Idaho Cedarmen's Association Specifications for Telegraph, Telephone and Electric Poles:

All poles must be cut from live growing cedar timbers, peeled, knots trimmed close, butts and tops sawed square; tops must be sound and must measure as follows in circumference: 4-inch poles, 13 inches; 5, 15; 6, 18.5; 7, 22; 8, 25; 9, 28; 10, 31.

No pole shall have more than one crook and this crook shall be one way only, the sweep not to exceed 1 inch to every 6 feet in length, to be determined in the following manner: Place a tape at the centre of the top and stretch to the centre of the butt; the distance from the tape to the nearest side of the pole at widest point shall determine the amount of sweep.

Butt-rot in centre, including ring-rot, shall not exceed 10 per cent of the area of the butt. Butt-rot of a character that impairs the strength of the pole above ground is a defect.

Large knots, if sound and trimmed smooth, are not a defect.

A perfectly-sound dead or dry streak shall not be considered a defect when it does not materially impair the strength of the pole.

Idaho cedar tapers approximately 1 inch to every 8 feet of length.

Editor.

Q—UNDERGROUND LINES

Q 1. What objections can you offer to laying high and low-tension conduits in a common trench?

Experience has amply demonstrated that, even with the very best of underground construction work according to present-day standards, breakdowns are likely to occur on both high and low-tension systems, where least expected. The intense heat given off on short-circuit may in a few seconds of time injure adjacent cables and do an immense amount of damage. Isolation of high and of low tension is a wise precautionary measure, and, where the size of installation will permit, high-tension ducts should be further sectionalized into two or more groups.

F. S. Chandler.

None whatever, provided that single ducts are used in the conduit construction and the cables are protected in manholes by a covering of asbestos tape.

J. W. McNamara.

Q 2. What is the maximum grade on which lead-covered cables can be installed in fire-clay ducts without special provision being made to prevent their slipping down?

A grade of 100 per cent is quite feasible if the cable or cables, in case there are several in one duct, approximately fill the duct. In such cases, the friction of the cable on the duct is sufficient to support it.

Figure 1 shows on the right a number of 1,000,000-cm concentric, low-tension cables and No. 0000, 3-conductor, high-tension cables, and on the left several city arc-light cables, all of which are installed in a vertical tile conduit in the shaft of a tunnel under the Chicago River. Most of the former are covered with split tile to prevent their injuring one another in case of burnouts.

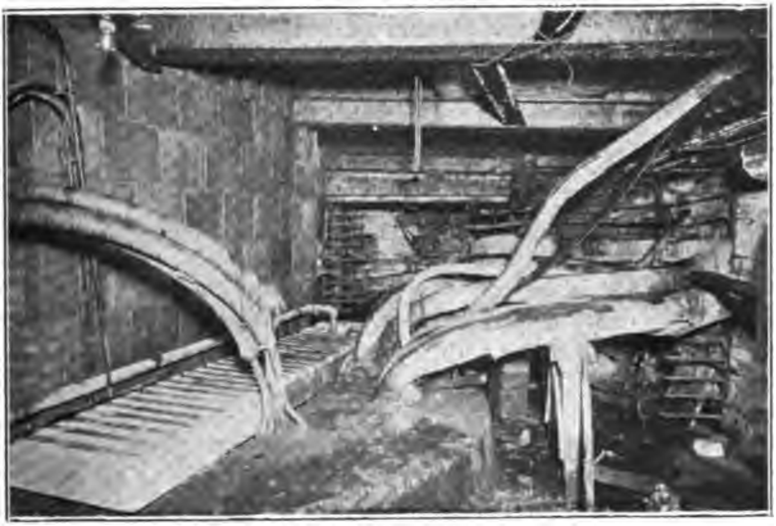


Fig. 1—Washington Street Tunnel

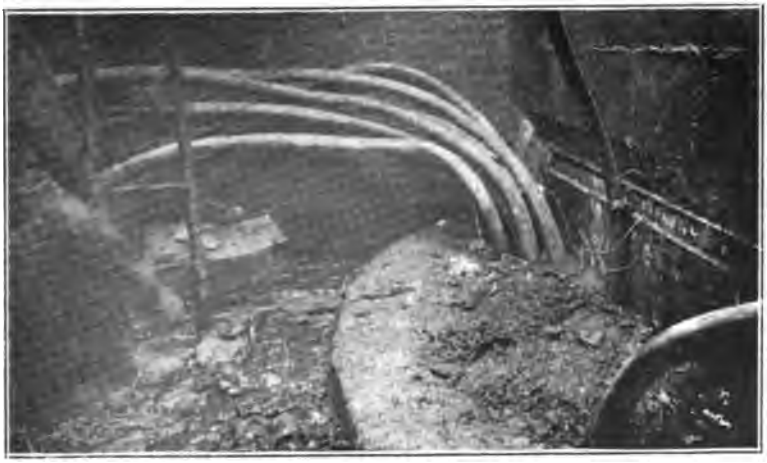


Fig. 2—Cables Entering Conduit

Split tile has also been placed around the bend in the cables which connect the vertical conduit in the shaft with the horizontal conduit in the tunnel. This tile will prevent the cable from slipping down. A clamp or wedge is generally placed on the cable at the top of the shaft, to prevent the cable slipping down while the men are installing the tile protection around the lower bend.

Figure 2 shows a number of telephone cables entering a vertical conduit in another tunnel. In this case the duct is continuous from the top of one shaft to the top of the other. Iron pipe is used in the shafts and bends, and McRoy vertical-duct conduit in the tunnel, with a special casting forming the connection between the iron pipe and the clay duct. The duct is, therefore, U-shaped, and there is no possibility of the cable slipping down.

Where it is desired to install a conduit on a steep grade, it would probably be sufficient to have the conduit extend for a short distance further with a grade of only a few per cent.

D. W. Roper.

We can not state definitely the maximum grade governing cables under these conditions, but we have conduits of from 70 to 180 feet in length which slope on an approximate angle of 30 degrees from the horizontal. Several lead-covered cables have occupied these ducts for over three years. No precaution was deemed necessary to protect them from slipping, and no creeping of cables has thus far been noticeable.

J. W. McNamara.

Q 3. What is the best method of holding lead-covered cables, to prevent their slipping, when installed in fire-clay ducts?

Clamp, using lead bushing between cable and clamp.

P. C. Oscanyan.

Q 4. What member companies are using lead-covered cable for transmitting 60-cycle current underground at 10,000 volts or over?

The Cleveland Electric Illuminating Company.

H. L. W., C. E. I. Co.

One of the companies with which the writer is connected has about 2000 feet of 3-conductor cable, transmitting approximately 2000 kilowatts at 13,200 volts. This is a submarine cable crossing a river.

F. C. Sargent.

United Electric department of the Public Service Corporation of New Jersey.

John J. Gaffney.

Public Service Corporation of New Jersey.

P. C. Oscanyan.

Q 5. What member companies are using lead-covered cables for transmitting 25-cycle current underground at 15,000 volts or over?

The Public Service Corporation of New Jersey uses lead up to 13,200 volts.

P. C. Oscanyan.

Q 6. How many systems with operating voltages higher than 20,000 volts employ underground cable for transmission purposes, and what success has been obtained?

Q 7. Is it practical to operate large underground, 60-cycle, alternating-current, secondary systems, using single-conductor lead-covered cable? If not, give reasons.

Large single-conductor lead-covered cables carrying alternating current are subject to lead losses unless the lead sheaths of all are insulated from each other. These lead losses increase with the frequency and with the amount of current carried by the cable. The existence of this loss in the lead sheath militates strongly against the use of single-conductor cables for alternating current.

P. M. Lincoln.

No. Induction.

P. C. Oscanvan.

Q 8. What success has been obtained in using insulated cables, not lead-covered, in underground conduits (duct system) on voltages of 2500 to 5000?

Q 9. (a) In running a 2200-volt primary line underground,

what precautions should be taken to prevent grounded line? (b) What kind of wire should be used? (c) What kind of conduit?

(a) Use care in installing, avoid sharp corners and bends, use care in splicing, and keep ends of cable sealed to keep out moisture.

(b) Lead-covered paper or rubber cable.

(c) Fibre or vitrified-clay duct is preferable.

P. C. Oscanyan.

Q 10. What is the best apparatus for making potential test of underground cables on large system?

That will depend very largely on local conditions, such as available apparatus, connections, and so forth. It may be advisable in some cases to use some of the existing apparatus in conjunction with a special step-up transformer. A separate testing set consisting of a motor-generator or an induction regulator, together with a step-up transformer, makes a very convenient arrangement. For a 3-phase system a 3-phase testing transformer greatly lessens the time necessary for a test over that required with a single-phase transformer, but the capacity of the latter need not be so large, the kilovolt-amperes for a single-phase test being about 45 per cent of the kilovolt-amperes of a 3-phase test.

R. F. Schuchardt.

Q 11. In a 4-wire, 3-phase, 2400-4000-volt distribution system in which no two feeders from station are interconnected and in which such feeders and part of the branches from feeder-ends will soon be almost entirely underground, what methods are used to locate and remedy trouble on the underground portions of such feeders?

Q 12. What has been the experience with underground or subway cutouts on 2300-volt cable systems in which the manholes are occasionally filled with water?

We have used, and I know others who have used, a weatherproof oil switch for subway cutout on 2300-volt cable system. The manholes have never been actually filled with water so that this switch has been submerged, the switch simply being weatherproof from water coming down on top of it. The sketch shown is of such a switch (see P 24). Would not advise this switch for a subway cutout if a manhole were to be filled with water so as to submerge the switch, but think the makers of the switch can easily make it waterproof if desired.

W. E. Holmes.

Good. The Public Service Corporation of New Jersey uses cast-iron box, gasket under cover and rubber expansion rings around cable.

P. C. Oscanyan.

Q 13. In a system of Edison 3-wire underground cable mains installed in conjunction with a system of 500-volt underground cable mains, what is the best method of taking off services from each system?

In either system, service cables may be tapped direct to the mains through a wiped joint. Such cables should be fused where they enter customers' premises, before connecting to service switches. Very large services, where the energy comes from more than one direction, as in an interconnected system, may be taken off the mains through junction boxes provided with fuses on positive and negative polarities and cables connected to same through protecting fuses. Ordinarily, neutral cables may be tied together without entering the junction boxes. Manholes containing junction boxes described should be provided with ventilated cover and drainage connecting to sewer system.

F. S. Chandler.

Q 14. What is the customary practice as to charging or not for putting underground service connection into residences and business blocks?

We charge for underground service $1.25 per foot, measured from the property line in through the cellar wall; and for this price we supply also the main switch and cutout. In case of business blocks that are on the street line, we make no charge for underground service connections.

W. E. Holmes.

We make a charge of 25 cents per foot for the conduit from the curb line into the house. The cable is installed by us and remains our property.

United Electric Light Co.

We locate our cutout at the most convenient place to the subway entrance, and the customer is supposed to run his wiring to this point.

M. C. Turpin.

Q 15. What is a reasonable length of time to allow an underground department for introducing service and connecting meter after receipt of a customer's contract?

Three days.

John J. Gaffney.

The length of time required to install underground service depends to a great extent on the conditions in each instance. On small ordinary services, after the order has reached the underground department, it requires one day to investigate the premises and procure the permit from the city to open up the street, and the following day the service can be installed and meter set and connected up by the meter department at the same time.

B. E. Strohm.

Q 16. How many times in 1906 were your cables out of service for repairs? Give character of insulation and dimensions of cable, size of copper, thickness of insulation, thickness of lead sheath, overall diameter and approximate length.

From one 9000-volt, 25-cycle transmission system I obtained the following data for the year 1905:

Total number of lines in service	40
" length " " " "	75 miles
Size of each conductor	No. 0000
Character of insulation	Paper
Thickness of insulation around each conductor.	$\frac{6}{32}$ inch
" " " " three conductors	$\frac{4}{32}$ "
" " lead sheath	$\frac{4}{32}$ "
Over-all diameter of cable	$2\frac{1}{8}$ inches
Number of burnouts during the year	2

G. W. Lunn.

Q 17. What would be the effect on a paper-insulated cable carrying 13,000 volts with a 3000-kw generator on each end, the distance between generators about five miles, if in case of attempting to parallel these generators, they should get out of step and buck

each other? Would it have a tendency to destroy the cable? If so, why?

Violent changes of current in underground cables tend to give rise to electrical oscillations which strain the insulation and frequently cause trouble. Generators operating out of step cause such violent changes, and, consequently, would impose certain additional strains upon cables. I do not think, however, that the strains thus imposed would be any greater than those occasioned by short-circuits. If the machines were thrown out of step by any mechanical cause or by hunting, I think that the strain on cable would be less than in cases of short-circuits on the line. If, however, the machines were thrown together without synchronizing, and in opposite phases, the effect might be very similar to that produced by direct short-circuit. Generally speaking, I think that there would be not much additional risk to line on account of the separation of parallel-operating generators.

W. L. R. Emmet.

It is well to note that the resistance of the circuit between generators running in parallel must be low, otherwise operation will prove troublesome or impossible.

When a generator is made to run in parallel with another it is cut in after synchronous speed is attained and its electromotive force opposes that of the line. If it were cut in one-half of a cycle earlier its voltage would add itself to the voltage of the first generator and we should have their added voltages acting from generator No. 2 along the line through generator No. 1, back along the other line and through generator No. 2; producing twice as bad an effect as a dead short-circuit. The voltage stress on the insulation would be but little above normal.

However, if one of the fuses should blow out or any condition arise whereby two leads of one machine would be on the line and only one of the other, then that side of the line which has but one lead connected to it will be subjected to a maximum voltage stress of twice the normal, while the other side has the normal.

John Cyrus Distler.

Q 18. How best contend with burning gas near high-tension cables?

Wherever it is possible to reach the source of supply, the gas should be shut off immediately. When a fire occurs in a manhole from burning gas, of course it is impossible to locate the supply unless it is coming through the ducts, and it is then sometimes possible to go to the next manhole and plug up the ducts. Where this is not possible, sand or some extinguishing material in powder form will sometimes smother the fire.

B. E. Strohm.

Q 19. In subway construction is it advisable to place fuse boxes on the secondaries of each transformer in the manholes, several transfomers being on the same feeder?

Yes. So as to avoid working on live wires and to cut out transformer in case of trouble.

P. C. Oscanyan.

R—TRANSFORMERS

R 1. What is a fair ratio between the connected capacity in transformers and the actual peak load on an alternating lighting system?

We assume that transformers are good for 25 per cent overload during peak-load period.

United Electric Light Co.

Sixty per cent, ordinarily.

J. A. Lane.

If load is residence and commercial lighting, 75 per cent.

H. Clyde Parrish.

The ratio depends largely upon the time the peak load is on. If the peak load is on for a half-hour period in a day, the transformers may safely be overloaded 50 per cent. Since the regulation of the transformer varies in proportion with the load, the drop in voltage may be a limiting feature, because during the peak load in lighting service customers will demand the best service at the time they are burning most of their lamps. Twenty-five to 50 per cent overload for ordinary peak loads can be considered safe practice.

E. A. Wagner.

In one plant with which the writer is connected, having much residential service, the peak-load lighting is one-half of the transformer capacity.

F. C. Sargent.

Depends on what load consists of. If motors and lights, and lights are scattered, connected capacity may be 50 per cent more than peak. If load consists of lights only, connected capacity can be very near actual peak.

W. M. Scott.

In a banked system, with 3-wire secondaries, assuming a peak load from 2 to 3 hours in the 24, 75 per cent transformer capacity to maximum demand would be a fair ratio.

N. Read.

R 2. What is the most practical method of determining the maximum load carried by transformers in service, in order that transformers of the proper capacity may be selected, thus avoiding too low capacity on one hand with consequent danger of burnouts, and too high capacity on the other hand with consequent unnecessary core loss, interest and depreciation?

The three-transformer method may be as much as one or two per millimetre less efficient, but this very slight disadvantage is more than offset by the improved regulation.

H. H. Barnes.

To determine the load on transformers, we have found the Wright demand indicator very useful. Install it on the primary side of the transformer and it will indicate the highest load during the month of greatest demand.

United Electric Light Co.
H. Clyde Parrish.
E. A. Wagner.
M. C. Turpin.

Some electric manufacturing companies make a current transformer of the split-ring type which can be clamped around a wire without cutting into it. These instruments as made by the General Electric Company are insulated for use on 2300-volt circuits and are furnished with leads and portable ammeters in two sizes, 125 and 250 amperes. The load on a transformer can be conveniently measured with these instruments. Small transformers are checked by measuring secondary, and large transformers by measuring primary current.

H. L. W., C. E. I. Co.
J. S. Reesman.
A. T. Lloyd.
Alex. J. Campbell.

The Wright demand meter seems to be the most practical and satisfactory method, connected in on the primary side of the transformer. We have a plug made with a cable, plug being a duplicate of the plug used on the cutout of the transformer, and by removing transformer plug and inserting this plug, cable being attached to a Wright demand meter, and leaving it in circuit three or four days or a week, we can ascertain the maximum demand on the transformer.

F. C. Sargent.

Use Wright demand meters of proper capacity with small hook to hang on cross-arm and plug to fit primary fuse block, putting meter in series with one primary lead. Test each transformer by leaving a Wright demand meter in circuit with it from 24 to 48 hours every three months, or oftener if deemed necessary.

H. C. Stoddard.

By the installation in series with the transformers, either permanently or temporarily, of Wright demand indicators. If connected on the primary sides of the transformers, these instruments can be of small capacity and consequently very cheap, and they can be readily cut in and out of circuit by means of leads permanently attached to primary fuse plugs. With these instruments, readings do not have to be taken at the moment of the maximum load, as the instrument records the maximum whenever it occurs. Guesswork is thus avoided. See *Loss Due to Surplus Capacity in Transformers, Electrical World,* April 22, 1905.

J. S. Codman.

If motor load, by tests; if lighting load, connect the houses and make estimate of number of lamps used in each house at one time. This can be done by maps showing size of transformer, size of wire, number of houses, distance, and so forth.

W. M. Scott.

R 3. In a business section where there is a transformer of about 150-light capacity on nearly every pole, is it better to run common secondaries and run all the transformers in bank or to run the transformers as separate units? The system is 2-phase.

Run common secondaries with transformers in bank, making two banks to balance load on each phase.

H. Clyde Parrish.

Run the transformers separate, because if for any reason the voltage of one is different from that of the others the load will be unbalanced, and one of the transformers may have to carry more than its rated capacity.

J. S. Reesman.

It is not advisable to have too many transformers banked together. We had an unfortunate experience where trouble, several times repeated, started at one end of a line of banked transformers and they went out one after another very much as a card house would fall. Without cutouts where the primary circuit branches from the main line, we had great difficulty in re-fusing the transformers in bank. The trouble has since been remedied as follows: Cutouts have been placed where the primary branch leaves the main line and each branch primary line is run straight through, but the secondaries have been cut into sections about a block long, and sections connected together by rather light fuses. Each section is supposed to have sufficient transformer capacity for its own requirements. Thus the various sections help out each other to a slight extent through the connecting fuses, but these will blow in case of serious trouble in one section and prevent the trouble from spreading farther.

Alex. J. Campbell.

It would be much better to bank the transformers on a secondary network. With this system, larger units of smaller total capacity could be used.

W. A. Carter.

Have obtained the best results by using large transformers banked in 3-wire secondaries.

R. H. Garrison.

Banks, under conditions named. Better practice would be to have larger transformers and wire of sufficient size to take care of drop and not bank transformers.

W. M. Scott.

If transformers are of the same make it is better to bank them and run a common system of secondaries. It would be better still to replace several of the 150-light transformers with one larger transformer, thereby saving in core loss, and gaining in efficiency.

M. C. Turpin.

R 4. Would it be good practice to connect in multiple the secondaries of two transformers whose primaries are connected to each phase of a 2-phase system?

No. The voltages in each coil are 90 degrees out of phase, and a short-circuit results if they are multiplied on the secondary side.

H. L. W., C. E. I. Co.

To connect in multiple the secondaries of two transformers whose primaries are connected to each phase of a 2-phase system would result in a short-circuit, due to the fact that the secondary voltages of each transformer are 90 degrees apart. It would be the same as connecting the two phases of a 2-phase generator in multiple. If one wire from each of the secondaries were joined together the voltage difference between the two remaining wires would be 1.1428 times the voltage of each secondary, so it is apparent that joining the last two wires together to complete the multiple connection would result in a short-circuit.

E. A. Wagner.
J. S. Reesman.

No, as this would obviate the advantages of a 2-phase system.

M. C. Turpin.

A consideration of the magnitude and phase of the two e.m.f. involved, shows that the result would be a short-circuit of a voltage 1.414 times the value of each of the secondary voltages.

W. A. Carter.

R 5. Have 2-phase transformers been found perfectly satisfactory for small power work when installed on pole lines for use with two-phase induction-type motors up to 30 horse-power? Is the satisfaction equal to that with single-phase transformers for same work?

Practical, but unsatisfactory, as it requires special transformers.

P. C. Oscanyan.

R 6. What is the smallest size of transformer advisable for use on a 3-wire secondary, feeding a few small consumers, so that any ordinary unbalancing would not be noticeable?

About 2.5-kilowatt.

W. M. Scott.

Five-kilowatt. If the number and size of consumers does not warrant the use of this size, it would be better to use individual transformers.

N. Read.

R 7. What is the relative efficiency at full load of two transformers connected 3-phase to 3-phase resultant delta, compared with three transformers of equivalent total capacity connected 3-phase to 3-phase delta?

Two transformers connected 3-phase have a 15 per cent current overload in each coil when carrying their full load in kilowatts at 100 per cent power-factor. This can be readily shown. At 100 per cent power-factor each transformer has a rated capacity of I amperes at E volts. The kilowatt load of both is $2EI$. Hence the total current delivered to the load is $2I$. This is equal to $\frac{2I}{\sqrt{3}} = 1.15\,I$ per wire. Since there are but two transformers the current per wire must equal the current in the coils. When a transformer carries an overload of 15 per cent the losses are usually increased about 30 per cent. Thus, a transformer having 98 per cent efficiency at full load when used for single-phase work, would have its losses increased from 2 to 2.6 per cent and its efficiency cut down to 97.4 per cent by such a 3-phase connection.

H. L. W., C. E. I. Co.

Since the capacity of the sets is the same, the losses are practically the same. In one case the loss is divided among three small transformers, and in the other the loss is divided between two larger transformers.

B. E. Morrow.

About 86 per cent.

W. M. Scott.

Two transformers connected in *Y* for 3-phase work are overloaded about 15 per cent in current over three transformers in delta of the same total capacity. This means that the copper loss is increased about 32 per cent, but as the iron and copper losses are approximately equal the total loss in the transformer is increased about 16 per cent. The same total capacity in two larger units will be cheaper and will have less total iron loss than when three smaller units are used. It is also more simple and is less work to connect up the two larger transformers on a pole than three smaller ones. Another point in favor of the two larger transformers is that if additional capacity is required later it is a simple matter to add the third transformer, thus completing a delta arrangement.

W. A. Carter.

R 8. What percentage of their rated capacity have two transformers connected in series for 3-phase work?

Eighty-five per cent. See answer to R 7.

H. L. W., C. E. I. Co.

If operated at its rated voltage the connection of the transformer does not affect its output capacity. The total 3-phase capacity of two transformers connected "in series" (questioner probably meant *open delta*) is the sum of their separate capacities. Thus, two 3-kilowatt transformers so connected are good for a 3-phase load of six kilowatts.

C. J. Embree.

About 86 per cent.

W. M. Scott.

R 9. Does it pay to test transformers in small stations of about 500-kw capacity?

Generally, no.

P. C. Oseanyan.

R 10. On high-potential transformers with underground secondaries, should the frame be grounded?

Yes.

J. S. Reesman.
John J. Gaffney.

Yes, we should advise grounding the frame.

M. C. Turpin.

R 11. What has been the experience in the smaller stations with grounded secondaries as to current loss and lightning effects?

All our house secondaries are grounded in the house cellar, or if we have secondary network it is grounded in the street. We have had three cases in the past year where, by reason of a ground coming on the house wiring, leakage took place through our meter. In two of these cases the defect in house wiring was caused by gas-lighting wires. We have had no trouble from lightning effects.

W. E. Holmes.

R 12. Do you make any test of ground resistance when grounding transformer secondaries? What resistance is allowable?

The secondaries of transformers may be permanently grounded at the pole by digging down and banding the city water pipe running through the street. We use a No. 4 wire and copper band about six inches wide. Around this pipe and band we throw in two or three bushels of cracked coke and fill in with dirt. An easier way of grounding secondaries of transformers is to ground them in the house cellar by taking a tap from one side of the circuit and connecting the other end of this tap to the city water pipe in the cellar at a point outside all fittings. Sketches of ground clamp are shown here.

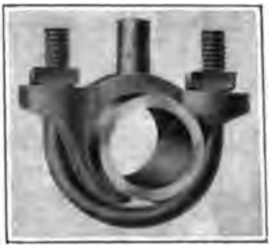


Fig. 1

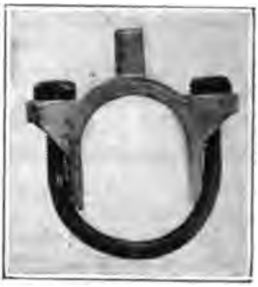


Fig. 2

W. E. Holmes.

Yes. Practically no resistance allowable.

P. C. Oscanyan.

R 13. How can secondary of transformer in lighting circuit be permanently grounded to prevent severe shock or damage in case of burnout or short-circuit between primary and secondary?

The best ground is to connect to water pipe. We have run ground wire several hundred feet to connect to hydrant rather than make ground connection on copper plate bedded in charcoal or coke, as a ground of this kind is a variable quantity, and the resistance may be high.

H. Clyde Parrish.

Ground neutral of 3-wire secondary system.

W. M. Scott.

R 14. How can service transformers for wireless-telegraph stations best be protected against lightning?

We adopted the following method, which has been in operation more than four months and, so far as we can ascertain, has given no trouble.

The wireless company has a 2.5-kw transformer, 110 to 25,000-volt. We put a pair of primary lightning arresters on our 10-kw transformer (which operates the wireless station only), also another pair of primary arresters in secondaries and two Leyden jars in multiple between service switch and key.

T. D. Smith.

R 15. What is the danger limit in temperature for oil-insulated and air-cooled transformers?

Experience has shown that any insulation subjected to actual temperatures of more than 100 degrees centigrade will deteriorate; the greater the temperature elevation above 100 degrees, the faster the deterioration.

P. M. Lincoln.

From an operating standpoint, about 40 degrees centigrade.

P. C. Oscanyan.

R 16. Have any attempts been made to cool air-blast transformers by expanding compressed air through an injector? If so, what were the results?

This scheme has been suggested many times but has never found favor among engineers on account of the large volume of air necessary to carry off a given amount of heat. The volume of air required for a given amount of cooling is somewhat decreased by expanding immediately before sending into the transformers, but there is not sufficient gain by this method to compensate for compressing the cooling air.

P. M. Lincoln.

R 17. (a) Is there ever more or less than 180 degrees phase-difference between the currents of the primary and secondary of a current transformer? (b) Ditto, potential transformers?

Yes. It is never exactly 180 degrees in either a current or a potential transformer, though so nearly so that 180 degrees is correct for all practical purposes.

H. L. W., C. E. I. Co.

Consider any transformer at no load. Its primary takes a magnetizing current which lags behind the impressed e.m.f. in phase from about 40 to 80 degrees, depending upon the design, physical properties of iron and so forth. Now with a load on the secondary the magnetizing current still exists, retaining its identity in magnitude and phase relation, but in addition, the primary takes amperes in phase 180 degrees ahead of that occurring in the secondary. Combining vectorially these two constituents we obtain the real current of the primary with its phase relation to the secondary.

Thus it is seen that they never are opposite in phase except when the current in the secondary happens to fall 180 degrees behind the magnetizing amperes. The difference is usually slight and depends upon the secondary load and phase position, also on that of the exciting current.

John Cyrus Distler.

R 18. Why can not current transformers be inverted as can be done with potential transformers?

They can be. It must be remembered, however, that a current transformer as usually designed is of very small capacity. Take, for example, a current transformer of 40-watt capacity, built for a primary current of 200 amperes, and a secondary current of five amperes. Assuming a non-inductive load, the drop across the primary at full load is 40 divided by 200, or 0.2 volt. If the secondary have eight volts difference of potential applied to it, while the primary is short-circuited through 0.001 ohm, five amperes will flow in the secondary, 0.1 volt will be generated across the primary and 200 amperes will flow in the primary circuit. Current transformers are rated for the voltages of the circuits on which they are to operate, but this rating is merely a measure of the insulation between primary and secondary and primary and core, not of the potential that can be transformed.

H. L. W., C. E. I. Co.

If you mean increasing a small current to a large current, this may be done without any trouble. We use them quite frequently in this way for testing purposes to obtain a large current from a small amount of energy.

F. C. Sargent.

We do not understand what is meant by inverting transformers, but if it means reversing the primary and secondary coils—that is, putting in small current through fine wire winding and taking off the heavy current from the winding—should say that this could be done, but we fail to see the advantage to be gained thereby.

M. C. Turpin.

R 19. Suggest a simple way of detecting moisture in transformer oil?

Take a few crystals of bluestone and drive off the water of crystallization, by roasting. To the white powder that is left add a small quantity of the oil that is to be tested. If the oil contains water, the powder will regain its blue color.—*Electrical Club Journal*, vol. i, p. 182.

H. L. W., C. E. I. Co.

If anhydrous copper sulphate is put in a test tube containing oil, the copper sulphate will have a bluish tinge if the oil contains water.

J. S. Reesman.

Heat the oil to the boiling point of water and hold a cold glass over it. If moisture is present in any quantity it will condense on the glass. To detect minute quantities of moisture—which may still have an appreciable effect upon the dielectric qualities of the oil—the high-voltage spark-gap test is the only one that is necessary.

H. H. Barnes.

By reason of its higher specific weight any moisture in transformer oil will be found at the bottom of the case. To detect, therefore, whether the moisture is present a sample should be taken from the bottom. As a rule, cases for shipment of oil, as well as transformer cases, have plugs at the bottom, which can be used to advantage for this purpose. The following represents a simple procedure to determine the presence of moisture: The sample obtained should be placed in an ordinary test tube that is provided with a cork at the top. The cork admits a glass tube about an eighth of an inch in diameter, the fit of which should be as tight as possible. The glass tube should be bent under an angle of 120 degrees. When the oil is placed in the test tube, proceed to heat the same. If moisture is present it will condense in the upper part of the small tube, which is bent to prevent the condensed water from dropping back into the oil. The amount of condensation is a means of ascertaining the amount of moisture present.

Wm. Lederer.

Heat a small piece of metal to a temperature just below red heat and plunge it into the oil to be tested. A crackling sound indicates moisture. This test is sufficiently accurate for the determination of moisture for ordinary lighting transformers. For high-voltage transformers more accurate methods, such as the breakdown test, give better results. For more detailed information, see paper entitled *Oil for Insulating Purposes,* published in 1904 Proceedings of the National Electric Light Association.

C. E. Skinner.

Insert a red-hot wire into some of the oil and if the slightest moisture is present a crackling noise, like the frying of grease, will be heard as soon as the wire touches the oil. If the oil is perfectly dry no noise will be heard and merely a puff of smoke will arise.

M. C. Turpin.

Drive off water of crystallization from a few crystals of bluestone (copper sulphate, $Cu\ SO_4 + H_{20}$) by roasting. To white powder remaining (anhydrous copper sulphite) add a small quantity of oil. If water be present, powder will turn blue.

If high potential is available for testing, put two spheres in vertical glass cylinder 2 inches in diameter, with one fixed and one capable of being adjusted by means of a micrometer screw. Bring spheres together and separate them a known distance with micrometer screws, apply the high-potential to the spheres and reduce distance between spheres until oil breaks down. With a separation of 0.15 inch 30,000 to 40,000 volts should be required.

B. J. Denman.

R 20. Give a convenient way of keeping transformer-load records.

Install a Wright demand indicator on each transformer and have meter readers reset it every month and report reading on a simple card system.

United Electric Light Co.

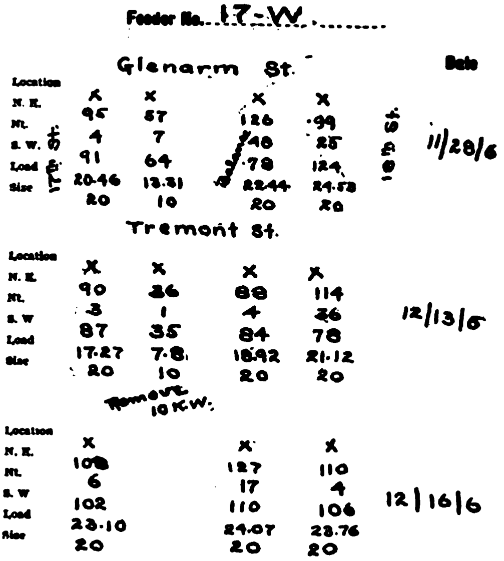
A transformer-load record could be kept in a loose-leaf file, an index card being inserted for each transformer number, which should show the capacity, number, make and size of secondary 'bus of transformer. After each index number, a page should be inserted for every service connected to the secondary 'bus showing connected load in 16-cp or hp-equivalent, number of outlets, character of load, size of service wires, meters, and so forth, so that the load of the transformer could be readily determined by adding up all services filed under its number. If the total number of transformers is too great for such a file a card system could be used in the same manner as the pages of the loose-leaf system.

G. M. Armbrust.

Card index. Different color transformer cards for each phase. All consumers' cards white, but connected load on one side of 3-wire secondary is entered in red ink and the other in black ink.

R. H. Garrison.

We test our transformers as described in answer to R 2, and the results are kept in a loose-leaf book. This book is kept up to date and shows the location of all feeders. The north and east and the south and west of all our 3-wire system are connected and the respective current readings of northeast and southwest are taken. Notations as to unbalancing or the setting of additional transformers are placed on sheets as shown here.



Feeder No. 17-W

Glenarm St.

Location	X	X	X	X	Date
N. E.	95	57	126	99	
Nt.	4	7	40	25	11/28/6
S. W.	91	64	78	124	
Load	20.46	13.31	22.44	24.58	
Size	20	10	20	20	

Tremont St.

Location	X	X	X	X	
N. E.	90	36	88	114	
Nt.	3	1	4	36	12/13/6
S. W	87	35	84	78	
Load	17.27	7.8	18.92	21.12	
Size	20	10	20	20	

Remove 10 KW.

Location	X		X	X	
N. E.	108		127	110	
Nt.	6		17	4	12/16/6
S. W	102		110	106	
Load	23.10		24.07	28.76	
Size	20		20	20	

N. Read.

S—LAMPS—ARC, INCANDESCENT, ETC.

S 1. Have any of the member companies had experience in the use of galvanized chain in suspending arc lamps; if so, how long has chain been in use, and what is the general opinion in regard to its use?

Have used galvanized-iron chain in suspending arc lamps for more than a year, and approve of its use over twisted-wire cable or rope.

W. E. Holmes.

We are using this chain with good results.

J. A. Lane.

I have been using Oneida galvanized chain for nine months on about 1800 lamps, without having (through the fault of the chain) a lamp fall to the street. It is a great money-saver over manila or wire rope.

W. W. Titzell.

We are using in all of our plants, for arc-lamp suspension, the galvanized chain called "The Oneida" and are having excellent success with same. It certainly seems to be preferable to any kind of rope that we have heretofore used.

F. C. Sargent.

Have used galvanized chain of the Oneida Community's make for two years, and find it entirely satisfactory. We use a special pulley which holds the arc lamp to the arm when suspended, and the weight of the lamp does not come on the chain continuously.

Wm. M. Lewis.

We suspended 51 of our street lamps on galvanized chain with a Cutter high-voltage insulator between the chain and lamp. In wet weather we found these chains dangerously charged, possibly due to leakage from the pole and cross-arm to chain. We replaced the chain with rope.

W. O. Haymond.

Our experience is that chains used in suspending lamps do not answer as well as galvanized hemp-centred flexible wire rope. Moreover, chain will not always run through the sheaves properly, and has made a great deal of trouble, very often necessitating the lifting off of the sheaves. For this reason, we have given up chain for the purpose of suspending arc lamps.

H. Frederic Frasse.

The Oneida galvanized chain fits all standard pulleys and works freely under all conditions. Ice and sleet do not interfere with its ease of operation. This was very strikingly demonstrated at Niagara Falls, where a certain light was close to the cataract and the chain subjected not only to all conditions of weather but to a continuous deposit of mist arising from the falls. The Buffalo and Niagara Falls Electric Light and Power Company reported that the chains on this system worked perfectly throughout the entire winter in spite of the severe conditions.

Vernon W. Lee.

We put up one sample chain over a railroad crossing in July, 1905. Inspection in April, 1907, did not show any corrosion or deterioration of chain. We used to change wire cables on these crossings once a year. We installed 42 chains in April, 1906, two of which developed defective links and dropped the lamps; otherwise we find them very satisfactory. We used an insulator on the lower end of each chain for the safety of the trimmer. During a recent sleet-storm the circuit equipped with chains was trimmed in much less time than a similar circuit equipped with ropes.

W. H. Fellows.

S 2. Is there any way of treating iron gas-caps on enclosed-arc lamps to prevent rusting?

Have tried various schemes, but without any satisfactory results.

J. W. Cowles.

The most satisfactory way to treat gas caps is to scrap them.

The Edison Elec. Illg. Co., West Chester, Pa.

We have been unable to find any method of treating iron gas caps on enclosed-arc lamps to prevent them from rusting. We have used various metals and alloys in place of iron, and of these one furnished by the General Electric Company seems to give fairly good satisfaction.

H. T. Hartman.

S 3. Do you find large reflectors of much benefit on enclosed-arc lamps in street lighting?

Large reflectors on arc lamps are useful in heavily-shaded districts, as they prove beneficial in holding the light on a line beneath the leaves. Where there is an open territory to be lighted they are of little use.

Wm. M. Lewis.

We find it dependent on the municipal authorities. Some prefer reflectors on lamps, while others do not.

John J. Gaffney.

In general, reflectors are desirable for all enclosed-arc lamps in street service.

J. W. Cowles.

We have found large glass reflectors very beneficial, as they protect the glass globes from hail, sleet, and so forth. In fact, the outer globe can be dispensed with when reflectors are used, which makes the light much more effective in dusty weather and requires much less time for trimming.

The Edison Elec. Illg. Co., West Chester, Pa.

Reflectors are not of much benefit in street lighting, except where the lamps are hung unusually high or where alternating-current lamps are used. In alternating-current lamps there is nearly as much light thrown upward as downward, hence it is virtually necessary with all alternating-current lamps to use a reflector to throw the light downward or in a more useful direction.

G. H. Rettew.

We do not use reflectors on enclosed-arc street lamps. It is our experience that the public estimation of a street lamp depends more on the brilliancy of the arc than on the diffusion of the light.

H. T. Hartman.

S 4. What combination of the various kinds of inner and outer globes has proven most satisfactory for street lighting in actual practice—that is, clear outer and light opal inner, and so forth?

The street-lighting committee of Springfield, Mass., prefers the opal inner globe and clear outer globe. Inner globes are washed once a week.

United Electric Light Co.

It is best to use clear outer and opalescent inner globes, but where a change is made from open to enclosed lamps the appearance of more light will be given by using both clear.

J. A. Lane.

Clear outer globe and opalescent inner globe seems to be the combination to use on street arcs.

Wm. M. Lewis.

We use clear inner and outer.

The Pueblo and Suburban Traction and Lighting Co.

Clear globes, both outer and inner, are used invariably for street service.

J. W. Cowles.

We have found a clear inner with no outer globe very satisfactory.

The Edison Elec. Illg. Co., West Chester, Pa.

The question of glassware for arc lamps is largely determined by personal preferences. All glassware will absorb a considerable amount of light, and opal glassware absorbs very much more than clear. However, where a clear outer globe is used in connection with an opal inner globe, the opal inner globe will so diffuse the light that it appears to emanate from the entire surface of the inner globe and the lamp will *appear* to give a greater volume of light, although in reality it gives less. Same will apply to the use of an opal outer globe, which appears to become luminous over its whole surface and adds somewhat to the appearance of the whole lamp, although as a matter of fact it absorbs from 15 to 40 per cent of its light, depending on the density of the glass. If you want all the light you can get, use clear globes entirely.

G. H. Rettew.

We have found the best combination to be clear inner and clear outer globes.

John J. Gaffney.

The best combination of outer and inner globes for street lighting is to have both clear. The clear inner will become opal shortly after it is in use. The average person will in nine cases out of ten, when passing judgment on an arc light, look at the lamp, and if the arc appears intensely bright he will conclude that the light furnished is superior to the light furnished through opal globes.

John McFeeley.

S 5. What are the chief troubles experienced in series alternating-current arc lamps for street-lighting system?

Our experience would indicate that the greatest trouble experienced in series alternating-current street-lighting systems is due to the facts that the lamps are not given sufficient attention and that in a great many cases the current is not maintained at its normal value. On all alternating-current lamps there is a tendency toward the formation of graphitic carbon, which when cold is a poor conductor of electricity, and when this formation occurs it is difficult for the lamps to pick up and they will frequently operate badly. This formation does not readily take place when the current is at its normal value, but if the current is allowed to run too low, or if the voltage at the arc is too low, this graphitic formation may prove a source of considerable trouble. The lamps should be adjusted at about 72 volts at the arc and be kept in adjustment by testing the lamps three or four times each year.

G. H. Rettew.

We find no particular trouble from series alternating-current arc lamps.

John J. Gaffney.

S 6. Assuming the carbons of an arc lamp to be kept at a constant distance apart, would the lamp give the same amount of light on eight amperes as indicated by an ammeter at 90 per cent power-factor as it would on eight amperes at 70 per cent power-factor? Would eight amperes always have the same heating effect in a conductor, irrespective of power-factor?

Yes.

J. A. Lane.

The power-factor of a carbon arc is always the same. Introducing resistance or reactance in series with an arc will make the arc more stable. It is well known that a reactance in series with an arc has a greater steadying effect than an equal resistance. If, then, the power-factor is reduced by the use of reactance in series with the arc, the arc will be more stable and will have a slightly higher temperature, and will give off more light. The heating effect of eight amperes in a conductor is always the same, irrespective of the power-factor of the load.

C. E. Stephens.

The lamp would give more light at 90 per cent power-factor than at 70, because the former condition represents more energy. The heating effect in both cases would be the same, because the loss of energy varies directly as the resistance, and as the square of the current, regardless of the power-factor.

W. O. Haymond.

Assuming that the conditions are as set forth in the question, any given number of amperes will produce as much light at a high power-factor as would be produced at a low power-factor. Similarly, a given current will have precisely the same heating effect in any conductor, irrespective of the power-factor.

G. H. Rettew.

As the heating effect is equal to the square of the current multiplied by the resistance, it is evident that the heating is independent of the power-factor, as the light emitted is due to the heat. It is also evident that with the same resistance and the same current the amount of light is also independent of the power-factor.

H. T. Hartman.

S 7. In testing series arc lamps do member companies find it necessary to test lamp on actual line conditions, or will an approximation of constant current suffice?

If wire is sufficiently large it should not be necessary to test on the circuit.

J. A. Lane.

In testing series arc lamps we test same on a small 6-light, constant-current transformer. We find this entirely satisfactory.

F. C. Sargent.

Lamps should always be tested and adjusted under current conditions as nearly as possible the same as service conditions.

J. W. Cowles.

Question does not state whether direct or alternating-current lamps are referred to. Direct-current can be tested in the stations and then put on the line without any further adjustment. Alternating-current series lamps, if tested at the station on a circuit that probably comprises only a few lamps on the testing rack, should be readjusted after being placed on the line, because the power-factor of a short testing line might be either very much lower or very much higher than the actual service line. However, they can be tested on one of the service lines, in the power-house or at any point on the circuit, and the adjustment would not necessarily have to be changed if the position of the lamp on the circuit were changed.

G. H. Rettew.

If you want lamps to be uniform, test them under actual line conditions.

The Edison Elec. Illg. Co., West Chester, Pa.

In calibrating series arc lamps it is very necessary to duplicate the line conditions. This can readily be accomplished by using a constant-current regulator of small capacity, such as five or six lamps, and loading the regulator the same as the regulator from which the lamp will operate; that is, if 60 lamps are to be operated on a 75-light regulator, a sufficiently close adjustment can be made by calibrating five lamps in series on a 6-light regulator.

C. E. Stephens.

We test all arc lamps with a constant current in station before placing them on line.

John J. Gaffney.

S 8. What is the real cause of the simultaneous hissing at the arc and drop in potential in an open-arc lamp?

S 9. Where series street lamps are giving considerable trouble

from carbons slipping, what can be recommended as an adequate remedy?

The trouble is evidently in the clutch.

J. A. Lane.

Buy straight carbons and get a new trimmer.

W. W. Titzell.

We have found that placing a stop on the trip platform to catch the clutch removes the difficulty.

John J. Gaffney.

Slipping of carbons is possibly due in most cases to using a smaller carbon than that recommended by the manufacturer. Take a piece of iron, say, three inches square and drill two half-inch holes; tap these holes out to correspond to the maximum and minimum gauge of carbons recommended by the manufacturer. By running all carbons through this gauge you can pick out the over-sized and under-sized carbons, as well as the more crooked ones.

W. O. Haymond.

If slipping of carbons is due to vibration, hang lamps on spring supports. If due to worn clutches, replace or repair them. If due to carbons of improper gauge, use a different gauge.

J. W. Cowles.

Neither series street lamps nor any other lamps should give trouble from the carbon slipping, because this is simply a defect in the design of the clutch, and if a lamp is purchased with a properly-designed clutch no trouble of this kind will be experienced.

G. H. Rettew.

S 10. What is the relative consumption of carbon in a lamp used on direct-current circuits and on alternating-current circuits?

We use only direct-current series enclosed arcs for street lighting. The life of a 12-inch carbon will average 110 hours, although under favorable conditions and careful inspection to secure a narrow range of diameters an average life of 125 hours can easily be secured.

H. T. Hartman.

S 11. What causes carbons to crystallize?

Low voltage sometimes causes this trouble.

F. C. Sargent.

Would refer you to answer S 5. In addition, it appears that the heat at the arc distills the carbon and the products of the distillation are deposited on the cooler surface, hence on direct-current lamps the deposit is usually found on the negative carbon; on alternating-current lamps it is found on both carbons, for the simple reason that the current reverses and the carbons are continually changing temperature and the graphitic carbon distilled from the amorphous will deposit on a cooler surface.

G. H. Rettew.

I should say the crystallizing of the carbon was due to the lamp being out of adjustment.

John J. Gaffney.

S 12. What proportion should the outages in street series-arc system bear to number of lamps in circuits?

We have operated 1000 series enclosed-arc lamps during the past twelve months with a reported outage of about 0.125 per cent. The outage is computed by four inspectors employed by us and from the police reports received by the superintendent of street lighting employed by the city.

United Electric Light Co.

Our outages, with strict reporting from the police department (1900 lamps), show 0.1 per cent during the year 1906; series open arcs.

W. W. Titzell.

The total lamp-hours out should not be much over 0.125 per cent of the total lamp-hours burning. Less than this is to be expected, and 0.25 per cent is high.

Alex. J. Campbell.

One-half of one per cent.

F. C. Sargent.

Arc lamps for street lighting should be considered as an advertisement of the central station's product, and for this reason, at least, street lamps should be kept in the very best possible condition. If all street lamps were taken from the circuits two or three times each year, taken to the shop, thoroughly cleaned and thus maintained in the best working condition, and if the trimmer were made responsible for outages, very few outages would be reported. We know of one system operating 125 lights on which no outages were reported for two months. This was in a large city where the police were very vigilant in reporting outages, hence will serve as an indication of what can be done under proper management. On another system of 107 lamps, where the company made a practice of overhauling two lamps every day, no outages were reported for three and a half months, and in this case the police were not only willing, but anxious, to report any lamps that might fail. As this company had only a few more than 100 lamps, and as it overhauled two lamps every day, this will indicate that each lamp was gone over about once in 60 days.

G. H. Rettew.

S 13. What percentage of the income from municipal arc lamps is it necessary to expend for trimming and inspection, to give good service?

It costs us about 1.5 per cent of income from street-lighting service to provide trimming and inspection.

United Electric Light Co.

About 5 per cent is paid out for trimming and patrolling. This includes labor and cost of horses and wagons for taking care of approximately 500 arc lamps and 3000 series incandescent lamps.

F. C. Sargent.

Ten to 15 per cent.

W. O. Haymond.

This depends upon the rates you are receiving and varies from 0.017 to 0.021 per cent where rates are from $70 to $95 per year.

John J. Gaffney.

S 14. What are the disadvantages of using magnetite arc lamps?

Magnetite arcs can not be used for interior lighting, on account of the fumes emitted. The current required is so small that to get the full capacity out of a standard direct-current dynamo a very high voltage must be carried in comparison with that required by any other system. The regulation of arc dynamos operating on so small a current is seriously affected by grounds that would not be noticed on a 9.6-ampere circuit, and would have little effect even on a 6.6-ampere system. If constant-current transformers are used rectifiers are required, the cost of maintenance of which is about equal to the entire cost of repairs to lamps, renewal of globes, cost of carbons and trimming. In an ordinary direct-current, enclosed-arc, street-lighting system the rectifier has the additional disadvantage of decreasing the efficiency and power-factor of the system.

H. T. Hartman.

S 15. What method has proved most practicable and convenient for closing a series-arc circuit when operated on mercury-vapor rectifiers in connection with magnetite arc lamps? The ordinary and usual method of jumping the line with series direct-current machine connected to lines, to indicate by current when open circuit has been closed, is not practicable, on account of failure of rectifier to pick up except on a closed circuit.

Start the mercury-vapor rectifier on short-circuit, close the arc-lamp circuit and open the short-circuit switch.

C. E. Stephens.

S 16. To what degree are the fumes of the flame arc noxious? Inquirer has seen a flame arc installed in a small store for illuminating purposes.

One flaming arc in a good-sized grocery store about 40 by 50 feet seems to give no annoyance.

C. R. Price.

Fumes given off by the carbons used in flaming arc lamps depend entirely upon the material used in the cores of the carbons. There is one lamp now being manufactured in this country in which the carbons will give off no more fumes than are given off by ordinary enclosed lamps.

G. H. Rettew.

S 17. What policy has been adopted as regards flaming arc lamps? Are they loaned by the supplying company? Where the consumer owns the lamp does the company trim the lamps? Is any additional charge made?

The present first cost of flaming arcs and the high cost of maintenance make it prohibitive to put them out on the same basis as the ordinary arc lamp. I understand that the present general practice is to have the consumer purchase the lamp and carbons and the company do the trimming and maintain the lamp.

John McFeeley.

A customer buys his flaming arcs and carbons of us at cost. We trim and care for the lamps the same as others, charging him merely for the current consumed.

C. R. Price.

The writer understands that at least one prominent manufacturer of flame arcs instructs his customers as to care and maintenance, thus relieving the central station of this annoyance. Under these conditions, with the customer furnishing his own carbons, and in view of the indirect advertising these lamps bring the electric company, the use of flame arcs should be encouraged.

E. C. Stahl, Jr.

We have adopted the policy of furnishing flaming arc lamps to our consumers at cost. We also do the trimming without additional charge; the consumers, however, furnish the carbons.

Fred Leslie.

For the purpose of introducing the flaming arc lamps, a small number were supplied to customers with monthly charge in addition to the current bills, the rental charge being sufficient to cover the extraordinary cost of the lamps and the increased cost of maintenance. Beyond the few furnished in this way, all flaming arcs are installed as customer's lamps and are trimmed and maintained wholly by the customer.

J. W. Cowles.

Central stations have not taken very kindly to the flaming arc lamps, but, in spite of this, large numbers are being installed, and it is only a question of time when the central stations will see that it is to their advantage to supply the flame arc lamps on the same conditions they now supply the enclosed lamps. There are several large central stations that are now supplying flame lamps at a fixed price per month, which price includes rental of lamp, current, trimming and repairing. There is no reason why other central stations should not do likewise, as they can increase the sale of current enormously and can fix their prices so as to cover the cost of trimming and maintaining the lamps, and the depreciation on the same. Some of the central stations do not go so far as supplying the lamp, but if the consumer purchases his own lamps the company trims them sometimes free, sometimes supplying only the labor free, the consumer furnishing his own carbons.

G. H. Rettew.

Our policy is opposed to supplying flaming arc lamps, or assuming responsibility for their maintenance, although we will furnish current for them if the consumer is willing to buy the lamp and take his own risks.

H. T. Hartman.

The customer owns and maintains the lamps. If necessary, the supplying company will demonstrate to a customer by installing the lamps for a certain time. If satisfactory to the customer, arrangements are then made for the customer to buy and maintain the lamps.

W. B. Thompson.

The company furnishes the lamp, but to cover the high carbon expense the charge is about double that for ordinary arc lamps.

J. F. Dostal.

S 18. Give average watts and volt-amperes per lamp at main 'bus-bars of switchboard for the various sizes and kinds of series-arc lamps; the figures to include all losses in translating and regulating devices and in line. State kind and size of lamps, whether alternating current or direct current; character of translating devices

—motor-driven generators, mercury-arc rectifiers, constant-current transformers, potential transformers and regulators, and so forth.

Alternating-current series enclosed 6.6-ampere arc lamps operating from 60-cycle regulating transformers: The true watts input to regulator equals 453; apparent watts, 600.

Alternating-current series enclosed 7.5-ampere arc lamps operating from 60-cycle regulating transformers: The true watts input to regulator equals 522; apparent watts, 690.

Direct-current series enclosed 6.6-ampere arc lamps operating from an induction-motor arc-generator set: The true input to the induction motor equals 747 watts; apparent watts, 838.

Direct-current series enclosed 6.6-ampere arc lamps operating from mercury-arc rectifier outfit: The true input equals 578 watts; apparent watts, 888.

C. E. Stephens.

Motor-driven arc generators have a combined efficiency of about 75 per cent in regular every-day use. Direct-current series enclosed-arc lamps will average from 500 to 525 watts each at the arc dynamo terminals. The average demand on the station for each lamp operated by motor-driven arc machines would therefore be about 660 watts.

H. T. Hartman.

S 19. Why are lamps for street lighting generally operated in series?

To keep the amperage low and also to operate on a single wire.

J. A. Lane.

For the reason that the distribution cost for lines is much less for series lighting than it would be for multiple lighting on a like number of lamps.

F. C. Sargent.

Street-lighting circuits are very long, and the use of series lamps permits the use of high voltage, thereby reducing the transmission losses.

B. E. Morrow.

To save copper.

The Warren Water and Light Co.

The amount of current is what determines the size of the wire. If it is desired to increase the amount of power this can be done by raising the voltage and keeping the current down and money can be saved in the wire put up. By the use of the series system, current is held down to minimum, consequently a small-sized wire can be used.

M. C. Turpin.

For economy in line investment, and for more ready control in turning on and off.

J. W. Cowles.

Street-lighting lamps are generally operated in series on account of the economy in copper and also for the reason that if they were operated on multiple circuits a short-circuit in a lamp would short-circuit the entire line.

G. H. Rettew.

S 20. The advisability of using series incandescent lamps being under consideration, what would be considered first-class regulation on the lighting system?

On a 5.5-ampere series circuit I should think the regulation should be within 0.1 ampere of normal.

F. C. Sargent.

S 21. What percentage of the income from municipal incandescent lighting (series) is it necessary to expend for renewal and inspection to obtain good service?

This is answered as a whole under S 13.

F. C. Sargent.

I believe five per cent per year to be a necessary allowance for good service.

John J. Gaffney.

S 22. What are the weak points of renewed lamps? Do they usually have a long life? Do they lose their candle-power rapidly?

I have used renewed lamps for the past six years and find them practically as good as new ones for a life of about seven-eighths as long as new, also find them economical to use. They do not lose their candle-power any faster than most new ones, statements to the contrary notwithstanding.

N. Wallace.

Loose bases, poor vacuum, low efficiency, wide assortments. On account of the low efficiency the life is long. There is no reason why the candle-power should fail rapidly.

The Warren Water and Light Co.

S 23. To what extent do frosting and sand-blasting reduce the light and life of incandescent lamps? What is the reason for the reduction in life?

From a series of tests made at the Electrical Testing Laboratories and published in the *Electrical World*, we find that the amount of light, measured in mean spherical candle-power, lost by frosting a standard 16-cp incandescent lamp by the acid-etching process averages on the whole about 10 per cent, while the loss of life due to this frosting is practically 50 per cent if we consider that the life of a lamp is exhausted at 80 per cent of its initial candle-power. If, on the other hand, the lamp is burned until the filament disintegrates and breaks, the life of the frosted lamp is probably as long as that of the clear lamp. Inasmuch as lamps are, or at least should be, replaced when they have lost 20 per cent of their original candle-power, frosting very materially cuts down the useful life. The reason for this reduction is probably found in the blackening of the globe, inasmuch as each ray of light reflected from the frosting back into the globe must pass through the carbon deposit on the inside of the bulb, so that all light reflected from the frosting must pass at least three times through the carbon deposit, thereby materially lowering the candle-power and the useful life.

V. R. Lansingh.

See *An Explanation of the Short Life of Frosted Lamps*, Edward P. Hyde, *Electrical Review*, April 6, 1907, and editorial.

Editor.

A properly frosted bulb cuts off very little light from the incandescent lamp; averaging but from three to seven per cent, or from one-half to one candle on a 16-cp lamp. The useful life of frosted lamps is about 60 per cent of a corresponding clear-bulb lamp, while the average or breaking life appears to be the same for both frosted and clear lamps. The increased decline in candle-power causing reduction in useful life of frosted lamps appears to be the result, according to Dr. E. P. Hyde, of the National Bureau of Standards, of greater interior reflection caused by the frosting.

F. W. Willcox.

Sand-blasting and frosting reduces the life and candle-power in proportion to the amount of frosting. The frosting obstructs or reflects back the light and heat rays perhaps a number of times, which causes the lamp to become hotter than it otherwise would; this causes a more rapid deposition of carbon on the inside of the bulb, which still further obstructs the light and heat rays. In this way the life is shortened by the abnormal amount of carbon deposited on the inside of the bulb.

The Warren Water and Light Co.

This question can be answered by reading *An Analysis of the Cause of Candle-Power Diminution in Frosted Lamps,* by Preston S. Millar, *Electrical Review,* April 20, 1907.

E. A. Taylor.

Useful life is reduced about 50 per cent. Reduction in candle-power varies with age, from 6 per cent in new lamps to 19 per cent in lamps after burning 470 hours. The reduction of useful life or the increased rate of diminution in candle-power is due to change of filament, increased absorption of light by carbon deposit—as half of the light is reflected and passed back through the carbon deposit and through the carbon deposit on the opposite side, half of this remainder emerging and half being reflected, and so forth—and to dust in the surface of the frosting.

B. J. Denman.

S 24. Where there is a large number of flat-rate consumers is it good practice to give lamp renewals?

No, unless forced to do so by competition.

The Pueblo and Suburban Traction and Lighting Co.

It is not desirable to give flat-rate consumers free lamp renewals. The cost of renewals might, when borne by the consumer, influence him in turning off lights when not needed. The flat-rater has enough advantage of the company without giving him free renewals.

John McFeeley.

Give renewals to your meter-rate customers only. This will tend to reduce the number of flat-raters.

The Warren Water and Light Co.

We do not think that free renewals should be given with flat rates, but the prices of renewals should be kept at cost or thereabout to control the quality of lamp used in the installation.

F. V. D.

S 25. Do you furnish GEM units, and if so, do you renew free?

We furnish GEM units free and make no charge for renewals.

W. E. Holmes.
United Electric Light Co.

We furnish GEM lamps and charge for same.

J. A. Lane.

We furnish GEM units at cost.

Bennington Electric Co.

At the present time we sell GEM units, including lamps, at list price, and renew the lamps free. This has not yet been adopted as a settled policy.

Alex. J. Campbell.

We charge for GEM units, but give free renewals.

Ludwig Kemper.

In limited proportions, not being able yet to get a full supply.

C. R. Price.

This company supplies and installs the larger sizes of GEM units with free renewals on the same basis as clusters and arc lamps. This policy has not been in effect for a sufficient length of time to give any data. In view of the advent of the inverted Welsbach lamp, it seems to be up to the central station to provide some liberal policy in regard to high-efficiency lighting.

E. C. Stahl, Jr.

GEM lamps are furnished liberally both for installations and renewals free, except in the case of the 50-watt lamps, which are supplied temporarily with a small excess charge. Shades, if furnished, are charged to the customer at standard retail prices.

J. W. Cowles.

Renew free.

W. B. Thompson.

Yes.

B. J. Denman.

S 26. Do you renew Meridian or GEM units when dim or blackened or only when burned out?

We have had some trouble with GEM units turning yellow, and have always renewed, without cost to the customer, those that have become discolored.

Bennington Electric Co.

Renew Meridian and GEM units when they are burned out or when they are half burned out—in fact, a new lamp every time.

Wm. M. Lewis.

We renew every lamp that is offered for renewal, provided bulb is not broken.

Ludwig Kemper.

We believe it good policy to do so.

C. R. Price.

When requested by customer.

B. J. Denman.

Renew when dim or blackened, for no matter how nicely your advertising department can mingle seven different colors to produce a "striking ad," your prospective customers will judge your output by what they see on other customers' installations.

E. C. Stahl, Jr.

We renew all deteriorated lamps.

The Pueblo and Suburban Traction and Lighting Co.

Either Meridian or GEM lamps should be promptly renewed when blackened, the same as any other lamps, without waiting for them to actually burn out.

J. W. Cowles.

We renew GEM lamps when they will not give a good light.

The Edison Elec. Illg. Co., West Chester, Pa.

Renew when blackened or dim.

W. B. Thompson.

S 27. Does it pay to install GEM lighting units (lamp and shade) at cost with free renewals?

We think it pays to give the public all the new things that come out, without charge. It is an easy way to find out their value.

United Electric Light Co.

We believe it pays to install GEM lighting units and any other current-consuming device at cost, but we do not furnish free renewals, as a rule, though we sometimes give a customer a lamp or so if they have burned out quickly.

Bennington Electric Co.

This depends on the rates and the efficiency at which you burn the lamps.

E. C. Stahl, Jr.

No, unless forced to do so by competition.

The Pueblo and Suburban Traction and Lighting Co.

We believe it pays to renew GEM lamps free and charge a nominal sum for the shade.

The Edison Elec. Illg. Co., West Chester, Pa.

On the basis of getting, keeping or pleasing a customer—yes.

W. B. Thompson.

Yes, require deposit for shade, to be refunded if shade is returned in good order.

B. J. Denman.

We find it very good business to do so.

Ludwig Kemper.

We make a charge approximate to cost for the first installation.

C. R. Price.

S 28. Where free incandescent-lamp renewals are given, does it pay to renew what is known as the GEM lamp for use in stores, offices and business places where a considerable amount of current is consumed?

See answer to S 25.

Alex. J. Campbell.

Our experience has been that it pays to install GEM units in stores where a great deal of current is consumed, as the customer is always better satisfied, and even adds to his number of lights, when he has a brighter service.

Wm. M. Lewis.

Considering a well-regulated system, certainly.

E. C. Stahl, Jr.

For long-hour burning it probably would pay.

The Pueblo and Suburban Traction and Lighting Co.

See answer to S 25.

Ludwig Kemper.

Yes.

J. W. Cowles.
W. B. Thompson.
C. R. Price.
B. J. Denman.

We believe it pays to furnish GEM lamps on free renewals in all business places, in sizes of 100 watts and over.

The Edison Elec. Illg. Co., West Chester, Pa.

S 29. What success have you had with GEM units for competing with the inverted Welsbach?

GEM units with Holophane reflectors should easily compete with inverted Welsbachs. Current at 10 cents per unit with free renewals, against $1.00 gas and cost of mantles. It must also be borne in mind that electricity need not quite meet gas in mere cost. Quality always has some bearing on value.

E. C. Stahl, Jr.

Very successful.

The Pueblo and Suburban Traction and Lighting Co.

Successfully in many cases.

J. W. Cowles.

Have found the GEM lamp a fairly good competitor with the inverted Welsbach.

The Edison Elec. Illg. Co., West Chester, Pa.

GEM units are more popular in our town than any other means of lighting. When we first introduced them, we at once secured four saloons that were previously using gasolene, which we had failed to secure with ordinary lamps, clusters or arc lamps.

Ludwig Kemper.

The Gem unit should be an easy competitor of the inverted Welsbach, since it requires a very high pressure to get any results from inverted gas mantles, hence a large consumption of gas.

S. C. Foster.

S 30. With the voltage constant does an old, nearly burned-out, metallized-filament GEM lamp consume more current than a new one? Does frosting of a lamp bulb have any effect on the amount of current consumed?

The current consumed on an incandescent lamp is purely a function of the resistance of the filament, and the frosting of the lamp bulb does not in any way affect it.

V. R. Lansingh.

An old, nearly burned-out GEM filament lamp consumes slightly less total watts than an old ordinary carbon-filament lamp does. For the same drop in candle-power of 20 per cent, the total consumption of current is reduced about 7 per cent below initial for the GEM, and 5 per cent below initial for the ordinary carbon filament. The frosting of an incandescent lamp bulb does not have any effect on the amount of current consumed.

F. W. Willcox.

S 31. From both central station and consumers' viewpoint, which is the more economical—efficiency, length of life, and price considered—the metallized-filament or the tantalum lamps on direct-current circuits?

As to whether it is desirable to use metallized filament, tantalum or standard carbon lamps, one must take into account the cost of current, the initial cost of the lamp and the number of hours of useful life. With lamps at the standard market price, it is, generally speaking, cheapest to use standard lamps if current costs not over 1.6 cents per kilowatt-hour; GEM lamps if current costs more than 1.6 cents and less than 4 cents per kilowatt-hour, and tantalum lamps, provided current costs more than 4 cents per kilowatt-hour. This has all been worked out in the form of a table, which is published by and can be obtained from the engineering department of the National Electric Lamp Association.

V. R. Lansingh.

We believe in urging our customers to use high-efficiency units, but we do not reduce the meter rate, as the customer gets more light with the same current consumption.

Bennington Electric Co.

Selling a high-efficiency lamp at a lower rate to meter customers is advantageous, for the reason that a customer can not be "too satisfied." Where they get additional light for the same money or even less, they will, as a rule, continually add to the installation until the bills are higher than they were prior to the installation of the high-efficiency lamps.

Wm. M. Lewis.

The metallized filament.

W. B. Thompson.

From the consumer's viewpoint, for rates above two cents per kilowatt-hour the tantalum lamp is more economical than the GEM filament; that is, the total cost of power and lamp renewals for an equal service of light, say 1000 candle-power, is less for the tantalum lamp than for the GEM for all rates above two cents per kilowatt-hour. To answer the question from the central-station viewpoint is very difficult unless all conditions affecting the conclusion are fully stated. The value to a central station of a higher-efficiency lamp, such as the tantalum, can not be directly shown. If a central station sold in light units (candle-hours) instead of power units (watt-hours) the conditions would be the same as those given above for the consumer, and the tantalum lamp would be more economical than the GEM lamp. Full answer to this question can only be obtained from a more extended discussion, such as is given in paper in the 1906 Proceedings of the National Electric Light Association on *Higher-Efficiency Lamps—Their Value and Effect on Central-Station Service.*

F. W. Willcox.

S 32. Has experience proved it advantageous to use a high-efficiency lamp, selling it to meter customers at a lower rate in order to keep them satisfied?

Sell high-efficiency lamps at cost and renew free.

E. C. Stahl, Jr.

Yes.

The Pueblo and Suburban Traction and Lighting Co.

S 33. What has been your experience with Nernst lamps as regards maintenance, rates and methods of charging, and so forth?

I have kept a record of the renewals and repairs for Nernst lamps for something over two years, and find that the renewal cost for these lamps, without labor, varies from one to two cents per kilowatt-hour. The life of the glower seems to depend entirely upon the regulation of the voltage. From the customers' side of the case I believe these lamps to be all right, but where the company has to maintain them I do not think them a very good article.

J. S. Reesman.

We have been using the Nernst lamps for a period of about one year. We have in our territory about 1300 lamps. We find the average life to be as follows: glower, 1056 hours; heater, 3900 hours; ballast, 4860 hours. Regarding the cost of maintenance, it is rather difficult to give the figures on this, as we have only a few customers that use the Nernst lamps entirely for illumination on meters, but from what data I have on hand it figures out a cost of 0.55 to 0.6 cent per kilowatt-hour.

John J. Gaffney.

Our experience with Nernst lamps has been very satisfactory. We buy and install 3, 4, and 6-glower lamps for our customers free of charge where the building is wired. We also maintain the lamp free but charge a minimum rate of $1.00 per month per lamp installed. Our cost of maintenance is low: 0.15 cent per kilowatt-hour, not including labor. The holders are changed by the same man that trims the arc lamps. All lamps are inspected once a week.

The Warren Water and Light Co.

Very expensive.

The Pueblo and Suburban Traction and Lighting Co.

Nernst lamp maintenance about half a cent per kilowatt-hour. A minimum charge of $1.44 per month for a 3-glower lamp, which equals 30 hours' use at 16 cents per unit, less 10 per cent. All current used in excess of the first nine units per 3-glower lamp is sold at four cents. A 3-glower lamp using 264 watts will cost, if used 150 hours per month, $2.64 gross.

W. B. Thompson.

S 34. Where the gas company puts in arcs on a rental basis, guaranteeing the mantles, what is considered the best basis on which to put out Nernst lamps?

Install the Nernst lamps free, charging only for current, the company maintaining the lamps in repair.

M. C. Turpin.

Furnish the lamps on a minimum-charge basis. Maintain them by regular inspection so that their average light is good, and sell the current so as to compete with gas. The Peninsular rate in Detroit will do.

W. B. Thompson.

See answer to S 33.

The Warren Water and Light Co.

Supply and maintain Nernst lamps free, making rates sufficient to cover expenses.

B. J. Denman.

S 35. What success has been obtained in the use of Nernst, Wolfram and tantalum lamps, and are free renewals made of these lamps?

The Nernst lamp is a good medium through which to get business in competition with gas-arcs. Tantalum lamps seem to be short-lived. Customers complain about frequent burnouts. The lamps are sold at 60 cents and renewed at 30 cents each.

W. B. Thompson.

S 36. What has been the experience, as regards life, with tantalum lamps operated on direct current?

From 400 to 500 lamp-hours.

Merrill Ry. and Ltg. Co.

As first made the lamps were satisfactory, but as made at present they are not up to the manufacturers' claims.

E. A. V., A. E. L. Co.

We have been able to get an average of above 600 hours' use of tantalum lamps on direct current. We find the life is greatly increased where the lamp hangs in a vertical position and is not subject to jar or to being changed around. The imported lamps have given us longer life than those of American manufacture.

Fred Leslie.

Have put out several thousand tantalum lamps on direct-current system with fairly good results, obtaining satisfactory life in the majority of cases. The percentage of early burnouts is naturally much greater than with the carbon lamps.

J. W. Cowles.

S 37. What is the voltage per foot of length in Moore tubes?

The voltage per foot of Moore tube is not a constant quantity; it varies with the length of the tube, and an average would be about 50.

D. McFarlan Moore.

S 38. How does the candle-power per foot of length vary with the kind and density of gas in the Moore tube?

The candle-power of Moore tubes in any color can be made to vary from zero to 50 if so desired by the customer, but for the same energy consumption a yellow color gives twice the illuminating effect of the pure white color.

D. McFarlan Moore.

S 39. What is the most effective means of illumination for stores, houses or halls—distribution by small units or by a few large central ones?

Small units properly distributed.

J. A. Lane.

We are firm believers in the use of high-efficiency units for stores and halls, and for residences we are using a great many 8-cp lamps with suitable Holophane shades.

Bennington Electric Co.

This is probably the broadest question in the whole *Question Box* and answered properly would take an entire book, inasmuch as three such different classes of illumination are mentioned, namely, that for stores, for houses and for halls, each of which requires separate study. In general, however, it may be said that small units properly distributed are more economical than a few large central ones, but that for stores where large areas are covered larger units are as a rule desirable, although this is subject to many modifications. For houses small units are generally desirable; in fact, the use of any lamp larger than 16-cp is seldom required if the illumination is correctly designed. In public-hall lighting there are many methods, and both distributed and concentrated illumination are better in different cases. For detailed treatment of the whole subject, see *Practical Illumination*, by Cravath and Lansingh.

V. R. Lansingh.

In general, better results may be expected from small units if properly distributed.

J. W. Cowles.

Distribution with small units for illumination. The customers generally prefer the large unit.

W. B. Thompson.

The most effective illumination is secured by breaking the source of light up into as small units as possible, reflecting the light with a proper shade, and decorating the interior of the building in light colors.

John McFeeley.

Illumination is much more effective if distributed in small units rather than concentrated in large units.

M. C. Turpin.

S 40. What is the best type of diffused illumination for offices where a large amount of clerical and stenographic help is employed?

GEM lamps with diffusing reflectors, or similar units located well above the range of vision and yet reasonably well below the ceiling. This removes the glare and tends to remove the reflection from glossy paper.

Douglass Burnett.

In large offices and drafting-rooms we have had good results with enclosed arcs equipped with concentric diffusers.

Ludwig Kemper.

What might be called direct-indirect lighting, as to place the lamps in the ceiling in bays behind ground glass so that the light is well diffused although the source is not concealed. This, in my opinion, has the advantages of both direct and indirect system, as in the direct system the glare of the lights would be somewhat painful to the eye, and in the indirect system, where the same uniform illumination prevails, when one looks up from a book or paper it is impossible to rest the eye by gazing at any darker portion of the room.

S. C. Foster.

In general, fairly bright general illumination, preferably from shaded units in the ceiling and well-placed desk lamps, will give the best results.

E. C. Stahl, Jr.

S 41. What is the best method of illuminating engineering offices and drafting-rooms?

Excellent results have been obtained by our company with Cooper Hewitt mercury-vapor lamps in letter-filing and shop departments where blue prints are used. While color values are peculiar, they do not seem to be objectionable on black and white or for blue prints, and the diffusion of light is very agreeable. This light is also excellent for blue-printing and should be in more general use for this purpose.

C. R. Meston.

Incandescent clusters for ceiling lights, a well-shaded lamp on each drafting table, and outlets or brackets near reference tables.

B. G. Jamieson.

See answer to S 40.

Ludwig Kemper.
Douglass Burnett.
S. C. Foster.

Mercury-vapor lamps or arcs with concentric diffusers for drafting-rooms. Arcs or GEM units for offices, depending upon size, height of ceiling, arrangement of furniture, and so forth.

B. J. Denman.

S 42. What is the best method of determining the required illumination for a given indoor space?

The best method is undoubtedly to use the unit of illumination or the candle-foot. Inasmuch as, generally speaking, this can not be given directly, it is best to make the approximate determination by means of candle-power per square foot, candle-power per cubic foot, and watts per square foot, having given the efficiency of the illuminant to be used. From these the candle-foot illumination can be determined, provided we know the photometric curves of the illuminants to be used, and if not satisfactory the amount of light can be altered accordingly.

V. R. Lansingh.

Papers appearing from time to time in the *Illuminating Engineer* and other journals give tables and other information regarding the illumination required for various purposes and for various conditions.

R. F. Schuchardt.

S 48. What is the best unit to use in comparing intensities of light?

The best unit to use in comparing intensities of light is an aged incandescent lamp that has been standardized either at the Bureau of Standards in Washington or at the Electrical Testing Laboratories in New York. With one that has been carefully standardized it is easy to make a secondary standard for ordinary testing work and preserve the original for making and checking new working standards. The original, however, should be checked from time to time at one of the above-mentioned laboratories.

V. R. Lansingh.

That will depend upon the use to which the illuminants are to be put. In some cases the mean spherical candle-power should be used, in others the mean lower hemi-spherical candle-power, while in some cases the horizontal rays will be the determining factor. In general, the mean candle-power of the *useful rays* on the illuminated area should be used, other things equal, such as quality, intrinsic brilliancy, and so forth.

R. F. Schuchardt.

T—HEATING, BATTERY CHARGING AND POWER

T 1. What success has been obtained with heating appliances, especially flat-irons?

Flat-irons bring a very satisfactory revenue.

Edward Peterson.

We have had excellent success with flat-irons. We have done very little with other heating appliances.

F. C. Sargent.

During the past eight months we have sold over four hundred 6-pound flat-irons and a number of miscellaneous appliances.

E. R. Davenport.

The widest field for the electric flat-iron is found in those places where the woman of the house does her own work and can therefore appreciate the time-saving and cleanly features of the iron. In establishments where there are numerous maids the people who do the buying can not so easily see the advantages.

E. C. Stahl, Jr.

Flat-irons are very satisfactory.

The Edison Elec. Illg. Co., West Chester, Pa.

T 2. Have you had any complaints of electric irons burning out when operated continuously at full heat while doing work?

Have received but few complaints about electric irons burning out. Those that we did receive were found upon investigation to be due to the fact that the person who had been using the iron forgot to turn the current off when through.

J. S. Reesman.

No.

F. C. Sargent.

Yes. When a certain make of iron was first put on the market the burnouts were numerous where the irons were in continuous use. Since then the iron of this particular make has given no great trouble, and its users are enthusiastic in praise of its good qualities.

E. C. Stahl, Jr.

Have had less than five per cent of irons give out during the first two seasons.

The Edison Elec. Illg. Co., West Chester, Pa.

We have never had any such complaints with irons of the newer makes.

Ludwig Kemper.

T 3. What is the most economical way of advertising and demonstrating electric irons?

Have your solicitor leave an iron with the lady of the house for a 30-day trial.

United Electric Light Co.

Stick printed slips on your residence customers' bills, showing a cut of the iron and briefly describing its advantages. Have your canvassers carry a sample and demonstrate it on your customers' premises.

E. R. Davenport.

Free trial for 30 days. Irons sold at cost. Women solicitors to introduce and a competent man to see that irons are properly installed.

E. C. Stahl, Jr.

If you want to get your irons installed, take them to your customers, demonstrate, and leave them on trial for one week. If solicitor is discreet very few irons will be returned.

The Edison Elec. Illg. Co., West Chester, Pa.

T 4. Is heating by means of electric lamps installed in heaters and radiators an efficient method?

No; because all energy transformed into light instead of heat is wasted.

B. E. Morrow.

It would seem to be. The ordinary lamp used for lighting has at best an efficiency of not better than five per cent, which would seem to indicate a heating efficiency of 95 per cent.

E. C. Stahl, Jr.

T 5. How much is the life of heating apparatus decreased when the devices are made for 220-volt circuits rather than 110-volt?

The life of the heating apparatus depends largely upon the design, size, and so forth. Inherently, those used on a 220-volt circuit will have the shorter life, although it is possible to design them to possess a longer period of usefulness. No very definite data are available on this subject.

John Cyrus Distler.

T 6. Should the Fire Underwriters refuse to pass an instantaneous water heater of 20-ampere capacity that loses less than 0.5 per cent of the current through the water as a ground?

T 7. What success is being obtained in pushing the substitution of electrically-heated devices in place of gas or steam-heated devices in industrial work?

The writer knows of an installation of chocolate heaters in a candy factory, where the substitution of electrically-heated pans for those formerly heated by gas not only gave more uniform and easily-gauged heat but were operated more cheaply than gas.

E. C. Stahl, Jr.

T 8. Is there much demand for small electric furnaces for fine brass, bronze and other alloy work?

No demand in our territory.

E. R. Davenport.

T 9. Chemists can use considerable current for electrolytic and heating work. Is any effort being made to increase such use?

Many territories present no opportunities in this direction. However, if the outlook is promising get a technical graduate who has some knowledge of electrometallurgy to make a study of each plant and determine advantageous applications of electricity.

The larger electrochemical industries segregate where, through water-power, current may be had at a very low figure, one with which the ordinary plant can not compete.

John Cyrus Distler.

T 10. Statements were made in a recent paper that several companies were prepared to quote very low rates for electrochemical processes on off-peak business. Has any progress been made in closing up business of this nature?

T 11. Has much progress been made in installing motors for small ice or refrigerating machines?

No. Few small merchants can afford to install refrigerating apparatus.

E. R. Davenport.

T 12. Is it profitable for a company to advocate small motors, such as one-eighth, one-quarter and even one-half horse-power?

It is certainly profitable to advocate the use of small motors or any other current-consuming devices.

H. Clyde Parrish.

Yes.

J. H. Enright.

We have several one-sixth-hp motors on sewing machines, which bring us very good business.

Bennington Electric Co.

Yes. Put them on your alternating-current service, and lighting will follow.

W. W. Titzell.

The writer believes it is.

F. C. Sargent.

I consider it advisable. We have a canvasser who sells nothing but small motors (0.1 to 1-hp).

E. R. Davenport.

The installation of small motors tends to popularize the use of electricity for power, which is profitable.

The Warren Water and Light Co.

It is certainly profitable to advocate the use of such small motors, for the following reasons among others: (a) The motors generally create a day load, which is always to be desired; (b) the motors generally create a demand that is largely independent of the season of the year, and thus create a steady load for the plant; (c) such motors used in households require no additional transformer capacity, and are used at times when the lighting load is not ordinarily used; (d) no special class of current is required for these small motors, as they may be operated from any of the usual lighting classes of current, from the same wiring, and on the same contract and meter; (e) in a relatively large city such motors are generally used for operating industrial sewing machines, and the class of operatives is such that each motor is often used a great many hours each day; (f) such motors do not involve supplementary expense in the sense that incandescent or arc lighting involves—the supplementary expense of renewals, care and trimming; (g) repairs on the small motors, instead of being an expense, may often represent a revenue for the repair-shop of the company, if not a profit.

Douglass Burnett.

T 18. Should a canvasser be expected to explain details of belting and shafting to a prospective motor purchaser, and if not, who should?

By all means, yes.

J. A. Lane.

A good canvasser should be posted on details of belting and shafting.

H. Clyde Parrish.

Yes, a motor salesman should be able to give data relating to shafting or any machinery a motor is to drive. If not, where is the purchaser to get his information?

W. W. Titzell.

Some one connected with the electric light company should be able to give these details. It is a matter of great importance in securing a power customer.

Alex. J. Campbell.

I think it is very difficult to find a canvasser able to do this intelligently. If you have such a man, I think it is well to let him explain this detail, as everything that is done by the company to help the customer obtains his good will more readily.

F. C. Sargent.

It is advisable for a canvasser to explain to customers all details such as belts, shafting, location for motor, and so forth. It impresses your customers as to the canvasser's ability.

E. R. Davenport.

Most assuredly. The prospect's interests are or should be the central station's interests and they can not afford to injure the prospect, for they will then have a dissatisfied customer, which is a poor asset for any concern. In order that they may be sure not to injure him they must assure themselves of being in a position to advise him to his own best advantage. Their only means of advising him is through the canvasser, who, if he does not know all the characteristics and adaptations of the motors he is recommending, is more than liable to injure his prospect, his company and himself.

Chas. B. Burleigh.

A good power solicitor should be able and willing to explain anything along these lines.

The Warren Water and Light Co.

To insure best results as to sales, a canvasser whose business it is to install motors should be able to give any information relative to belting, shafting, size of motor required and current consumption.

E. A. Taylor.

If the canvasser can not explain such things you would better teach him, and if he *does not learn* you would better get one that can. This does not mean that he must necessarily be able to lay out the complete drive for a large factory, but he should be able to tell the butcher who is buying a motor about how large a motor it will take to run the meat cutter and what pulleys and shafting will be necessary to get the proper speed and transmission.

E. C. Stahl, Jr.

Some one in the company, either a special solicitor, a power man, or in a small company some member of the operating force, should have experience along the lines of the economical arrangement of motors and the best disposition of the motors with reference to the work to be done and with reference to any belting and shafting required, and should advise the customer in every case of a prospective motor installation as to the most efficient means, and at the same time the best all-around means, of using power from the standpoint of saving space, securing the necessary speed control, and so forth.

Douglass Burnett.

By all means. Too much can not be done by the solicitor to assist the customer in finding out just what he wants. A large proportion of the customers are likely to be small power users and are not at all familiar with the details of belting, shafting, and so forth, so are usually more than glad to have some one who does know explain it to them.

M. C. Turpin.

T 14. Give figures to be used to show the advantage of electric power over steam or other power.

It is necessary to know the conditions; it is seldom that any two cases are similar.

W. W. Titzell.

"The items enumerated below are those that should be considered in making up the total cost of operating an isolated plant:

Salary of engineers	
Salary of firemen	
Salary of electrician	
Fuel	
Removal of ashes	
Water	
Oil	
Repairs to boilers	2 per cent
Repairs to engines and dynamos	2 per cent
Tool account	
Miscellaneous expense and supplies, waste, packing, and so forth	
General expense	
Depreciation (10 to 15 per cent)	
Interest on investment	
Insurance	
Rental value of space	
Damage resulting from heat and vibration	
Risk to employees and the public through accidents and boiler explosion	
Taxes	

"In addition to the above plant costs it is often necessary to add the following:

Maintenance of rope or belt transmission lines....................
Unnecessary investment in shafting and hangers............ ..
Salary of millwrights ...."

[Proceedings of the Association of Edison Illuminating Companies, 1903.]

Editor.

T 15. Having a 2-phase, 4-wire system, is it economical and practical to operate single-phase motors?

On a 2-phase, 4-wire system, or, in fact, on any polyphase system, it will be found that it is more economical and practical to install and operate single-phase than polyphase motors, especially for small power work. The price of the single-phase motor itself is somewhat higher than that of a 2-phase motor of the same capacity, but a considerable saving is effected in the accessories. It is obviously less expensive to put in one transformer for the single-phase motor than two or three for the polyphase, and as a matter of fact this saving amounts to from 10 to 50 per cent, while the saving in wiring, cross-arm space, pins and insulators, meters, fuses, and so forth, is in the same proportion. One central-station manager reports saving no less than $100 on the installation of a 10-hp motor. In smaller units there is the additional advantage in single-phase motors that they can be installed on the lighting circuit, while a polyphase motor requires special power transformers or special wiring to reach the other phase of the distributing system. In the larger units (5-hp and up) the main advantage of the single-phase motors, in addition to those already mentioned, lies in the fact that they are made automatic in operation, and that thus the starting current required, as well as the starting torque, is predetermined and not dependent on the ignorance or mischievousness of the operator.

Wagner Elec. Mfg. Co.

We prefer to have small-size motors (2-hp, or smaller) single-phase.

H. Clyde Parrish.

If it is at all possible to run three or four wires into the building, use the 2-phase motor, as it is cheaper and better.

M. C. Turpin.

It is feasible to operate single-phase motors on either circuit of a 2-phase, 4-wire system. It is economical to do so only when the motors are of relatively small capacity and when cost of installing the extra 2-phase service wires is not offset by a consideration of the lower efficiency of the single-phase motors as compared with the 2-phase motors.

R. S. Feicht.

T 16. Which motor has the better power-factor, the single-phase or the 2-phase motor?

The power-factor on the running conditions is slightly better in the case of the 2-phase motor, but this is a small item and can be compensated for by the switchboard attendant. The starting power-factor, however, which can not be compensated for, is 22 per cent or thereabouts for the polyphase motor, while it is 65 per cent for the single-phase motor.

Wagner Elec. Mfg. Co.

The 2-phase motor has the better power-factor.

M. C. Turpin.

The single-phase motor has the better power-factor.

John J. Gaffney.

As a rule, the standard lines of commercial single-phase motors have lower power-factors than corresponding 2-phase motors, excepting where condensers are used with the single-phase motors.

R. S. Feicht.

The 2-phase motor has the better power-factor, especially if single-phase commutating motors are included in the question.

John Cyrus Distler.

T 17. Which is the more efficient on a 2-phase, 4-wire system —single or 2-phase motor, considering the small extra expense of connecting a 2-phase motor?

If the efficiency of the motor itself were alone to be considered there would be a difference of 1 to 2 per cent in favor of the 2-phase motor, but considering the question of total efficiency from switchboard to motor pulley, the single-phase motor leads the 2-phase motor by a wide margin, owing to decreased line and transformer losses.

Wagner Elec. Mfg. Co.

If the extra expense of service connections for a 2-phase motor is inconsiderable, a 2-phase motor will be more economical than a single-phase motor of corresponding size by reason of its higher efficiency.

R. S. Feicht.

The 2-phase motor is more efficient and there is no more actual expense in connecting the same, beyond the actual running of one extra wire, as the two middle legs of the 2-phase system can be joined into a common wire.

M. C. Turpin.

T 18. Are single-phase elevator motors commercially successful?

They are.

J. H. Enright.

T 19. Is the control of a single-phase elevator motor positive in its action, or does the elevator operator have to try two or three times to stop at a floor?

Single-phase elevator control is as positive as any other system of mechanical control known, whether for electrical or hydraulic installations.

Wagner Elec. Mfg. Co.

The control is positive. Of course, the matter of stopping at a floor depends upon the skill and practice of the man running the elevator, as well as upon the load on the elevator.

John J. Gaffney.

T 20. (a) What is the best type of brake of electric hoists? (b) Best type of emergency brake? (c) Weak points of electric cranes?

T 21. Can an ordinary single-phase motor be reversed, and how?

Yes, by reversing the starting-winding connection.

J. H. Enright.

An ordinary split-phase induction motor can not be reversed while running, nor is it practicable to use it as a reversing mechanism for operating a machine backward and forward. It can, however, easily be connected to start and operate in whichever direction is desired by reversing connections of the phase or starting coil. (*Note:* This answer will not apply to all forms of single-phase motors, but only to those which have their main and starting coils in shunt with each other, in which case the change of connection for reversing is similar to the change in an ordinary direct-current shunt motor.)

C. R. Meston.

All first-class single-phase motors may be reversed. Each company furnishes directions how to do this.

F. C. Sargent.

The motors of the Wagner type can be wound for reversing by means of a switch, and any one of them can have its direction of rotation reversed by means of shifting the brushes.

Wagner Elec. Mfg. Co.

An ordinary single-phase motor can be reversed. If it is an induction motor with a starting winding it can be reversed by reversing the connections of either the main or the starting winding. If motor is hand-started, it will run in either direction, depending on which way it is started. If it is a series motor, it can be reversed by reversing the connections of either its armature or field.

R. S. Feicht.

Where hand-starting is used, a single-phase induction motor will revolve in either direction, depending alone in which direction one gives it its initial spin. If the belt is pulled forward quickly enough it will continue to go forward. If it is pulled backward the motor will rotate backward. This is practicable only for very small machines.

With split-phase motors, reverse the connections of the starting coil.

With single-phase commutating motors, reverse the connections of the series field.

With the Wagner single-phase motor (which starts as a repulsion machine) change the angle of the lag of the brushes to an equal one of the lead, and reverse rotation will result.

John Cyrus Distler.

The ordinary single-phase motor can not be reversed, but has to be turned around end-for-end if it is not running in the proper direction.

M. C. Turpin.

Yes, by interchanging the leads.

B. E. Morrow.

To reverse the Wagner single-phase motor it is only necessary to shift the position of the brushes on the commutator.

John J. Gaffney.

T 22. Can a 133-cycle motor be easily changed to 60 cycles, and how?

Not easily. It will be necessary to rewind it for one-half the number of poles to give approximately same speed. If the motor has solid projecting poles this can not be done, as the shape of the iron can not be changed. If it has symmetrically toothed field it can usually be rewound by the manufacturer for approximately one-third to one-half the original cost of the machine. Certain ceiling fans for 133 cycles are arranged to change connections, change kind of blades, and operate at about one-half original speed, giving good results with different kind of blades on 60 cycles. In all cases the manufacturer of the apparatus is usually the only safe guide to what can or can not be done with each individual type of motor.

C. R. Meston.

Any 133-cycle motor can be operated for the same horsepower on a 60-cycle circuit by simply changing the governor spring (and pulleys if the same speed is desired on the driven machine); although the losses under these conditions would be greater than with a motor wound for 60 cycles. A 220-volt, 133-cycle motor would be connected to a 110-volt tap on a 60-cycle transformer. When such a motor is rewound for 60 cycles its rating is raised from 50 to 100 per cent, and in most cases the rewinding of such motors costs less than the difference in the price of the two ratings.

Wagner Elec. Mfg. Co.

Assuming that the question applies to a single-phase induction motor of the squirrel-cage type, a 133-cycle motor can usually be changed to a 60-cycle motor by changing the primary winding. The winding for 60 cycles should be arranged for half the number of poles used for 133 cycles to obtain approximately the same speed. The output of the motor for 60 cycles may have to be reduced somewhat, both because the amount of metal in the core for 60 cycles may be insufficient for the normal rating, and because the general proportions of the 133-cycle motor are not the best for a 60-cycle motor. The manufacturer of the motor should, of course, be consulted before attempting to make any change in the windings.

R. S. Feicht.

A 133-cycle motor can not be changed to 60 cycles without changing the entire winding and laminations.

M. C. Turpin.

To change a 133-cycle motor to 60 cycles, it is necessary to completely change the windings in both stator and rotor, and this can not be done at all easily.

John J. Gaffney.

T 23. Why do some central stations have difficulty in selling single-phase motors?

Because the price is so much in excess of that of the 3-phase motors. If motors are installed on separate feeders from the lighting, I should not object to using motors as large as 25-hp. Where motors are installed on the lighting feeders, I should limit the size to 5-hp.

F. C. Sargent.

On account of the cost of the motor. Most prospective consumers can not understand why they are asked a higher price for a motor than that paid by some other consumer who has a polyphase motor.

R. H. Garrison.

This is undoubtedly due to the high price of the single-phase motor, also to the unsatisfactory operation of a large number of them; but the first cost is the most prohibitive feature.

M. C. Turpin.

This is probably due to the lack of ability in the central-station man to convince the people of the merits of the single-phase motor and to relieve them of their scepticism on this point, as well as to convince them that it is best to keep up with the times and take hold of a good thing when it is put on the market.

John J. Gaffney.

T 24. With generating units of 1000-kw capacity, Tirrill regulators and ample copper in feeders, how large sizes of single-phase squirrel-cage motors can be used without seriously affecting the lighting regulation? The load on generators is mixed lighting and power, but no lights are installed on power feeders.

Forty horse-power.

Wagner Elec. Mfg. Co.

Would not recommend placing over a 5-hp, or possibly a 7.5-hp, single-phase motor unless for some special reason a polyphase motor could not be used.

M. C. Turpin.

The largest single-phase motor we use is one of 40-hp capacity. This motor is operated on smaller generating units than the one mentioned in the question, but under the same condition, and is found to be entirely satisfactory. As a direct answer to the question, I would say that the largest single-phase motor made at present (40-hp) can be operated with more than satisfactory results.

John J. Gaffney.

T 25. Why are nearly all the central-station companies in the largest cities in this country objecting to the installation of small-size polyphase motors?

Polyphase motors require the running of more wires and hanging of more transformers, the latter increasing your transformer loss.

J. S. Reesman.

The necessary installation of special wiring for power circuits is not justified for small motors under 0.25 to 0.5-hp. The single-phase motor in small sizes is very satisfactory for most uses. It is usually most convenient to connect small motors to single-phase *lighting circuits* which reach all parts of the building. The installation is much more flexible, as the motor can be used or placed anywhere a lighting circuit reaches without special circuits, and in most cases is plugged into a socket. Incidentally, the cost of operating most small motors is so small in comparison with results obtained that users would prefer to have the flexibility of service obtained in connection with lighting circuit, and it is a benefit to the station to have this small service on the higher rate where it belongs.

C. R. Meston.

The reason why we object to installing polyphase motors is the excessive installation cost over that of a single-phase motor. The writer believes this is the objection of other central stations.

F. C. Sargent.

We did not know they were.

M. C. Turpin.

One reason is that the polyphase wattmeter is much more expensive than the single-phase; also, unless there is a 3-phase secondary network, the 3-phase motor requires at least two small transformers, while the single-phase motor can be operated from one large transformer.

W. A. Carter.

T 26. Our station is only a small one and we have lately had a good deal of trouble with line disturbances owing to the starting of polyphase motors. Is the same trouble likely to occur with single-phase motors?

All types of induction motors make some line disturbance when started. Wagner single-phase (5-hp or less), however, will make much less than polyphase.

H. Clyde Parrish.

Yes.

J. S. Reesman.

I see no reason why you should not have exactly the same trouble with single-phase motors. I should advise the installation of a Tirrill regulator, provided you have sufficient capacity in your feeders.

F. C. Sargent.

The disturbance due to the starting of single-phase motors is smaller than that of polyphase motors, for the reason that the starting current of the single-phase motor is only two and one-half times full-load current, while the starting current of a polyphase motor is from 6 to 12 times full-load current.

Wagner Elec. Mfg. Co.

Yes, and more of it.

M. C. Turpin.

Yes, the same trouble is likely to occur. With the better class of polyphase motors, using auto-starters or compensators in starting, and with single-phase motors using clutch pulleys or secondaries free to rotate on their shafts in starting, the starting current of the two types is practically the same.

R. S. Feicht.

T 27. I have often heard it stated that a single-phase motor is cheaper to install than a polyphase motor. How can that be, when the price of the single-phase motor is so much higher than that of the polyphase motor?

From the central-station viewpoint, and when customers purchase their own motor, it is cheaper to install single-phase motors in small sizes (3-hp or less), for the following reasons: There are only two wires to run instead of four; one single-phase meter instead of two single-phase or one multiphase meter, and oftentimes motors may be connected on the secondaries of lighting mains, thereby doing away with extra transformers.

H. Clyde Parrish.

Single-phase motors cost more than polyphase motors, but require only one transformer and two wires.

J. S. Reesman.

I think you have been misled by not having this statement in more detail. It is cheaper from a central-station viewpoint to install a single-phase motor than a polyphase, as the central station does not purchase the motor, but simply stands the cost of installation.

F. C. Sargent.

See answer to T 15.

Wagner Elec. Mfg. Co.

The only saving in installing the single-phase motor over the polyphase is the extra length of wire saved, which, of course, amounts to very little; in one type of single-phase motor this is more than compensated for by the several leads that have to be run between the starting-box and motor. Of course, the price of the single-phase motor is much higher than that of the polyphase motor.

M. C. Turpin.

T 28. Given the full-load current of a motor, what rule do you apply in determining the fuse capacity to be used? (a) For direct-current motors? (b) For alternating-current, single-phase motors (Wagner type)? (c) For polyphase motors?

(b) For Wagner single-phase motors fuse for 100 per cent overload. (c) Fusing of polyphase depends on conditions. Small sizes without starting compensators should be fused to five times their full-load rating, as a motor cut in on line without compensator draws about five times as much current as its full-load rating; where compensator is used and fuses are not cut in until after compensator is cut out, 100 per cent above full-load rating.

H. Clyde Parrish.

(a) Full load.
(b) One hundred and fifty per cent.
(c) Three hundred per cent.

Wagner Elec. Mfg. Co.

(a) Use underwriters' rules. (b and c) Fuse branch blocks for all alternating-current motors for three and a half times rated current of motor. Fuses at compensators, according to Underwriters' rules.

B. J. Denman.

T 29. Is it desirable to install and advocate the use of 2300-volt, 3-phase induction motors? If so, at what sizes have you found it advisable to change from 110 and 220 to 2300 volts?

Would advise 110 and 220 volts for 10 horse-power, 440 volts for 15 to 50 horse-power and 2200 volts above 50 horse-power.

H. C. Stoddard.

It is not only undesirable, but it is prohibited in a good many cases and should not be done under any condition unless in a very large installation where an experienced electrician is in charge. The Underwriters will not approve of this except in very rare instances, and under very stringent rules.

M. C. Turpin.

T 30. How are 2300-volt motors installed and wired so as to be absolutely safe to apparatus and satisfactory to Underwriters?

The Underwriters' rules vary in different localities.

M. C. Turpin.

T 31. What is the best argument in favor of motors as against fuel-oil engines up to, say, 25 horse-power?

The advantages of an electric motor over a fuel-oil engine is mainly in the fact that it requires less attendance under ordinary conditions of operation. It is also more reliable and costs less to maintain in good operating condition. It is clean, practically noiseless, and its use reduces the insurance rate in the building in which it is used by 50 per cent as compared with the fuel-oil engine.

Wagner Elec. Mfg. Co.

The one best argument is reliability.

E. C. Stahl, Jr.

It is hard to say what is the best argument. Among the best are, reliability, smaller space, less attendance, easier operation, ease with which same can be duplicated or replaced by larger units, large overload capacity, noiselessness, variation of speed, and so forth, *ad libitum*.

M. C. Turpin.

T 32. What is the best way of obtaining variable speed on machine tools using alternating-current motors, and which are the best types of motor to use, single and polyphase?

Variable speed on machine tools with alternating-current motors should be obtained by mechanical means of some kind. Many manufacturers now make special types of self-contained machine tools for use with a *constant-speed* motor that may be single-phase, polyphase, or direct-current. Among these types may be mentioned Mechanics' drill press, Prentice lathe, Hendey tool lathe, Brown and Sharpe milling machine, and Jones and Lamson turret lathes. In cylindrical grinding machines, automatic screw machines, and so forth, the variable speed must still be obtained by use of regular, but somewhat complicated, countershafts necessary for their operation. On these latter it will often be found economical to use individual motors to each counter-shaft, in order to allow the better placing of the machine, but usually such machines are operated in groups, the constant-speed motor operating the group-drive shaft. The decision in regard to single or polyphase motors will depend upon operating conditions and relative cost.

C. R. Meston.

The best way of obtaining variable speed on machine tools, using alternating-current motors, is by means of a positive-geared speed-box. The best type of motor to be used is the single-phase motor, on account of the greater simplicity and economy in installation and operation.

Wagner Elec. Mfg. Co.

T 33. Are multi-speed alternating-current motors satisfactory in starting with full load? Load to be power pumps.

Properly-designed multi-speed alternating-current motors are satisfactory for starting under full-load torque.

R. S. Feicht.

T 34. What is the best method to determine whether we have the two phases on a 4-wire service or whether all four wires are connected in on the same phase, primary side? Can it be determined

with a voltmeter, and if so, what readings should be obtained? Service furnished, 220-volt, 2-phase.

Connect one secondary wire of one transformer to one secondary wire of the second transformer. If the voltage across each secondary is 220, the voltage across 1-4 wire will be 1.41 × 220 = 310 volts if connected across two separate phases, but it will be 0 or 440 if both transformers are connected across the same phase.

H. L. W., C. E. I. Co.

A voltmeter having a range of at least twice the voltage of one phase is all that is necessary to determine whether the four wires are connected in on the same phase or on different phases. First, determine the two wires of one phase. Measure the voltage between either of the wires of the first phase and both of the wires of the remaining phase. If a zero reading is obtained in each case, this will indicate that the remaining wires are not of the same phase relation. In any case, a zero reading should be obtained between one of the wires of the first phase and either or both of the wires of the remaining phase. Join together the wire of the first phase and the wire of the second phase between which there is a zero potential. Now measure the voltage between the wires that are not connected together. If a voltage of 220 is obtained it will indicate that the four wires are from the same phase. If these wires are of different phases on a 2-phase circuit, the voltage reading will be the square root of 2, or 1.414 × 220 = 312 volts. In making these tests care should be exercised not to join any two wires together unless the voltmeter indicates a zero potential.

E. A. Wagner.

The best way would be to connect them to a polyphase motor. If they are connected on the different phases, motor should run. If they are connected from the same side the motor will run single-phase, provided it is started, but after running a short time will blow fuse. It can not be determined by a voltmeter.

M. C. Turpin.

We assume that the four wires to be tested out come from the 220-volt secondaries of two separate transformers, the primaries of which may or may not be connected to the same phase of the supply circuit. By means of an alternating-current voltmeter of at least 440 volts' range, determine leads from each transformer. Each pair of leads will give a reading of 220 volts. Connect one wire of one pair to either wire of the other pair, and measure the voltage between the two remaining wires. If the voltage is zero or 440 volts the primaries of the transformers are connected to the same phase, but if the voltage is 1.41 × 220 volts, or 310 volts, the transformers are connected to different phases.

R. S. Feicht.

T 35. To what extent will the efficiency of a motor be affected if operating under full load with surrounding temperature 90 degrees?

The efficiency of a motor will not be affected, apparently, through ordinary range of temperatures.

B. E. Morrow.

T 36. Investigating a direct-current motor-starting rheostat, we discovered a large momentary current in starting. For instance: a 30-hp, 110-volt motor, tested at manufacturer's works, meets all requirements; after installing under same conditions the motor draws 400 amperes from the line at starting. What is the cause?

The starting current of a motor varies considerably with the manner in which it is started. If the handle of the rheostat is moved over the first two or three buttons very quickly, the current will reach a considerably higher value than if the handle is brought to the first contact button and allowed to remain there until the motor has attained very nearly its full speed, with that amount of resistance in the circuit. It is probable that this is the reason why the motor in question takes what seems to be an excessive amount of current.

M. C. Turpin.

Granting the rheostat resistance tested out all right and no short-circuit or change in connections developed between the time of test at factory and test by customer, we see no reason why the results should not be the same in each case. It is a fact, however, that some manufacturers design a starting resistance that will allow an initial current of 50 per cent overload. This, we believe, is the case here. That is, the actual total resistance in the rheostat is approximately 0.3 ohm. On 110-volt line this would allow an initial current of 370 amperes, but should the voltage of the line be 115 or 120 at times, the current would be 400 amperes. Then, again, considering that the resistance was designed for 50 per cent overload on motor, the shop would require a margin on which to work, and if this margin were as high as 10 per cent either way, that on 110-volt circuit would account for 400 amperes initial current.

F. D. Hallock.

T 37. The strength of a solenoid depends upon the ampere-turns. If the turns and amperes are kept constant, does a change in power-factor have any effect?

No.

J. A. Lane.

Power-factor will have no effect so long as the ampere-turns are kept constant.

B. E. Morrow.

U—METERS

U 1. In view of the simple and accurate means of determining the load connected to recording wattmeters by counting the disc revolutions, would it not be well to have a small window opposite the disc in the cover of all meters, such, for example, as on the Thomson high-torque meter? This would avoid the necessity of unsealing the meter every time a disc reading is desired.

Yes; a great many meters are thus made.

J. A. Lane.

It certainly would.

J. H. Enright.
E. A. V., A. E. L. Co.

The writer thinks it is very desirable to be able to observe the disc revolving in any meter, so as to avoid removing cover or unsealing meter in making test. There is less liability of changes being made in the condition of a meter on testing in this way than when covers are removed.

F. C. Sargent.

A window opposite the disc in the cover of meters is not desirable, as it is likely to lead to superficial and inaccurate tests which will make the customer dissatisfied.

O. J. Bushnell.

It would be well to have a small window opposite the disc of all meters, as it would be convenient in more ways than one.

L. D. Grim.

Every meter should have a window over the disc.

The Edison Elec. Illg. Co., West Chester, Pa.

Windows in cover opposite disc have proved advantageous in induction meters, and there seems to be no reason why their use should not be encouraged in direct-current meters. Anything that will tend toward giving the customer greater confidence in his meter is certainly a good thing, and the window will many times be a great convenience to inspectors of the company.

J. W. Cowles.

All modern types of electric meters have small windows in the cover, including the Thomson high-torque meter. Thomson recording wattmeters, type M, do not generally have covers with windows, but can be had when so ordered.

L. J. Hartman.

All makes of meters now have the small window, with the exception of the Fort Wayne type, and on that use the dial glass.

John J. Gaffney.

For good performance, brushes and commutators of direct-current meters have to be examined and cleaned more frequently than it is necessary to make a calibration; consequently, an opening in the meter cover opposite disc is not necessary, as calibration can be made when cover is removed to examine brushes and commutators.

Wm. Bradshaw.

This is a very good method and should be adopted on all meters; it saves a great deal of time, and more frequent inspections can be made.

Robt. J. Clark.

I certainly would.

The Warren Water and Light Co.

U 2. From the meter reader's viewpoint, what diameter of meter dial is the best?

As large as practicable, so they may be read from a distance.

J. A. Lane.
J. H. Enright.
The Edison Elec. Illg. Co., West Chester, Pa.

The large dials that are being put on the late type of meters. They are made to read in kilowatt-hours.

E. A. V., A. E. L. Co.

The diameter of the plainest meter dial now in use is seven-eighths of an inch.

O. J. Bushnell.

The type of dial now standardized in General Electric meters appears to be entirely satisfactory, both as to position and diameter of circles—approximately seven-eighths-inch.

J. W. Cowles.

The largest and clearest that can be obtained with all pointers on the same level.

L. D. Grim.

In most localities electric light companies' rules prohibit the installation of electric meters over six feet from floor, in which case a meter dial three-quarters of an inch in diameter is the best.

L. J. Hartman.

That now used on the General Electric type *I*.

John J. Gaffney.

A seven-eighths-inch dial is large enough and can be seen and read from a very satisfactory distance without making any mistakes.

Robt. J. Clark.

One inch.

The Warren Water and Light Co.

U 3. What shape of hand is the most advantageous for a meter dial?

As large as practicable, provided it is pointed.

J. A. Lane.

Straight strip with blunt end.

E. A. V., A. E. L. Co.

A straight hand without arrow head is best for meter dials.

O. J. Bushnell.

A straight, slim hand would cause fewer mistakes by the meter reader.

L. D. Grim.

A plain hand, such as is used on Fort Wayne type *K* meters, is most advantageous.

L. J. Hartman.

A hand about one-thirty-second-inch in width, with the pointer on one side only and long enough to extend over the figures of the dial to the outer edge of circle.

Robt. J. Clark.

A plain, simple shape, pointing in the direction of the reading only.

Wm. Bradshaw.

Plain, straight hand, without arrow-head.

The Warren Water and Light Co.

A plain, straight black hand at least one-thirty-second inch wide at point.

J. W. Cowles.

U 4. In small-capacity meters both sides of the circuit pass through the meter, while in large meters a potential tap only is brought out. At what capacity is it best to draw the line?

We think this is provided for by the makers.

J. A. Lane.

In meters of 50-ampere capacity and above, a potential tap only.

O. J. Bushnell.

We consider from 75-ampere capacity up. Leads for meters of this capacity or over contain such an amount of copper that to pass both sides of the line through the meter might not only materially increase the production cost but would necessitate enlarging of the entire meter.

Geo. Ross Green.

Both sides of circuit should pass through a 50-ampere meter, but not through a 75-ampere meter.

L. J. Hartman.

At about 100 amperes, or that size where the extra copper would add weight and cost and be of no extra advantage.

John J. Gaffney.

The limit of both sizes of line passing through the meter should be determined by the size of cable becoming difficult to handle in connecting up and throwing strain on the meter.

Wm. Bradshaw.

The safest way is for both sides of the circuit to pass through all meters, as it is a greater protection to the company against theft of current. The potential tap is all right for station meters, but on the consumer's end I think we can not be too safe; both sides should run through meter and meter be properly sealed.

Robt. J. Clark.

It depends somewhat upon size of wiring mains rather than of meter itself, but single-pole loop with potential tap is desirable for 50-ampere capacity and over.

J. W. Cowles.

U 5. In various makes of meters the binding-posts for the connecting wires are so arranged that a screwdriver must be used either from the front, sides, top or bottom of meter. Which is the most desirable position?

From the front, if possible, as it often happens that a meter is so near ceiling as to make a top application of screwdriver difficult.

J. A. Lane.
J. W. Cowles

In front, and at bottom of meter.

E. A. V., A. E. L. Co.

At top of meter, but so that screwdriver can be used from front.

F. C. Sargent.

Terminal posts in meters should be so arranged that screwdrivers can be used from the front of the meter.

O. J. Bushnell.
H. Clyde Parrish.
J. H. Enright.

The binding-posts should be arranged so that a screwdriver can be used from the front in every instance.

L. J. Hartman.
The Warren Water and Light Co.

The binding-posts at the top and front of the meter prove very satisfactory.

L. D. Grim.

Wall meters should be so arranged that the screwdriver can be used directly in front, as meters have to be set in various positions. You are continually placing them in positions where something will interfere with using the screwdriver on either side, top or bottom.

The Edison Elec. Illg. Co., West Chester, Pa.

Binding-posts should be arranged with access to binding-screws from front of meter, the same being in separate terminal chamber integral with the base of meter.

Wm. Bradshaw.

Binding-posts on the sides.

John J. Gaffney.

A meter should never be installed over seven feet from the floor. At this distance, if a meter is connected from the sides with the screws in front, a man can very easily stand on a chair and make all connections without having to take the meter down or getting a short-circuit. The bottom connections are practically the same if screwed from the front, but the top connections are very inconvenient and not desirable.

Robt. J. Clark.

U 6. What are the principal difficulties with and objections to chemical meters of the direct-reading type, and the advantages, if any, as compared with the motor or moving-element type?

The objections are the necessity of frequent refilling and inability to be read accurately with current passing through them.

E. A. V., A. E. L. Co.

Disadvantages:

(a) Essentially ampere-hour meters, and reading watt-hours only with an assumed voltage.

(b) Difficult to handle.

(c) Usually of poor overload capacity.

(d) Not readily tested in service.

(e) Tendency toward scale and reading errors.

(f) Necessity of resetting to zero, under some conditions at frequent intervals.

Advantages: No potential loss and somewhat cheaper in initial cost.

J. W. Cowles.

The term "chemical meters" used in this question no doubt refers to the Bastian electrolytic wattmeter, as, so far as we are able to learn, it is the only direct-reading chemical meter on the market. One of the objections to this meter is that it can not be made in large capacities. Owing to the great space it would occupy, it is hardly practicable to make it above 20 amperes. The Bastian meter depends for its registration on the decrease in the volume of a solution of water and alkali, the latter being introduced to reduce the resistance of the solution and to prevent freezing. The decrease in volume of the solution is read from a straight-line scale, and when the solution is entirely decomposed the tube has to be filled with water. The meter is therefore practicable only for small consumers, say up to 15 or 20 16-cp lamps.

The advantages of a meter of this type are that it is accurate, will remain accurate indefinitely, requires no repairs nor adjustments and will positively register all the current that passes through it, irrespective of how small that current may be.

G. H. Rettew.

U 7. Give the shortcomings of the Bastian wattmeter. What are the points in favor of this meter?

See answer to U 6.

E. A. V., A. E. L. Co.

Bastian meters are too delicate for general use; require too much time to connect and disconnect. Range in capacity is not great enough.

L. D. Grim.

An exaggeration of disadvantages mentioned in U 6, and, in addition, the impossibility of taking an accurate reading while current is passing through it, due to gassing of liquid.

J. W. Cowles.

See answer to U 6

G. H. Rettew.

U 8. Are prepayment meters entirely successful? If not, why?

We have installed experimentally 125 prepayment meters. To date they have been satisfactory, and to some extent have secured customers that would not otherwise use electricity, particularly in cheaper-grade apartment houses. Advantages are —no bookkeeping, no collecting, no bad debts.

Frank W. Smith.

We have about fifty in use at the present time and are putting more in as rapidly as we can obtain them. We have found them, thus far, very satisfactory.

F. C. Sargent.

Consumers economize seriously, the mechanism gets out of order, sneak-thieves rob the money boxes and damage the meters.

The Pueblo and Suburban Traction and Lighting Co.

We believe they are. Our trouble thus far with this kind of meter has been that we can not get enough of them.

The Edison Elec. Illg. Co., West Chester, Pa.

Practically successful, mechanically and electrically.

J. W. Cowles.

Prepayment meters are entirely successful for the class of service for which they are intended.

Wm. Bradshaw.

U 9. Has the installation of electric prepayment meters been satisfactory, or warranted by any accruing benefits?

We are using these meters very extensively at the present time on customers that do not always pay their bills readily and require a great deal of the collector's time each month, making the revenue from these customers much less than it should be. This trouble is being entirely eliminated by the use of prepayment meters and seems to be very satisfactory to these customers.

F. C. Sargent.

Cash deposits are preferable.

The Pueblo and Suburban Traction and Lighting Co.

Yes.

The Edison Elec. Illg. Co., West Chester, Pa.

Prepayment meters have proved satisfactory, owing to the simplification of the accounting department, reducing expense and satisfying the customer.

Wm. Bradshaw.

U 10. Where companies make minimum charge what provision is made for prepayment meters when the amount deposited is less than minimum?

Should the amount collected by prepayment meter be less than minimum charge, have your consumer pay you the balance due as per your regular minimum rate.

J. H. Enright.

Same minimum is imposed as on straight meters. The employee tapping the box is instructed to collect the balance of minimum.

The Pueblo and Suburban Traction and Lighting Co.

Have to make the rate a little higher.

The Edison Elec. Illg. Co., West Chester, Pa.

Minimum charge should be disregarded, giving consumer part of the benefit of the reduction in expense.

Wm. Bradshaw.

U 11. Are two-rate meters in successful operation on installations requiring 800 to 1000 kilowatts? What is the best method of installing?

Two-rate meters now on the market are not satisfactory.

Wm. Bradshaw.

U 12. What has been your experience with the Wright discount meter on alternating-current motors?

I see no reason why Wright demand meters are not satisfactory for obtaining the apparent watts on alternating-current motors, and as the apparent watts is the limiting feature in the capacity of your lines and generators, I think this is the amount that should be obtained, and your charges that are applied to this amount should be made in accordance instead of reducing these readings and trying to approximate apparent watts.

F. C. Sargent.

We have very good results.

John J. Gaffney.

May be used with fair result by applying power-factor correction.

J. W. Cowles.

U 13. If Wright demand indicators are used to ascertain the demand, what should be the limit; i. e., for how long a period should they be adjusted before the maximum is registered?

The longest time-limit obtainable in Wright demand indicators is 90-per cent registration in about five minutes and full registration in thirty to forty minutes. A longer time-limit for the 90-per cent registration would be desirable.

O. J. Bushnell.

I think ten minutes should be the minimum period for which these instruments should be adjusted.

F. C. Sargent.

It depends largely upon the character of the load, as to how long a demand meter should be left in circuit. As a rule, we leave them in circuit for at least 30 days.

L. D. Grim.

For about half an hour.

John J. Gaffney.

The standard Wright demand indicator registers about 95 per cent of the load in about ten minutes, and this seems to be satisfactory in the majority of cases. Special instruments can, however, be made with considerably longer time lag.

J. S. Codman.

The natural curve for the Wright demand indicator shows 90 per cent registration in approximately 4 to 5 minutes and full registration in 20 to 30 minutes.

J. W. Cowles.

U 14. Are maximum-demand indicators, of the Wright type, successful on single-phase, alternating-current power installations for establishing the discount on demand rates?

Wright demand indicators have not proved successful on single-phase power installations, owing to the excessive starting current and varying power-factors of alternating current.

O. J. Bushnell.

I think this is answered under U 12.

F. C. Sargent.

In our experience we found the Wright demand meter satisfactory on single-phase, alternating-current loads. The only trouble experienced was when there was a rise in voltage, which affected the rate of discount considerably.

Wm. M. Lewis.

Practically answered under U 12

J. W. Cowles.

Yes. Of course the Wright demand indicator, being an ampere-meter, does not take account of power-factor, but this is, on the whole, desirable since it is the maximum amperes, not the maximum watts, that determine size of central-station generators, transformers and mains.

J. S. Codman.

U 15. What method is used in determining capacity of meter placed on installations where the ordinary load is only a small part of the total installation, as in residences?

We take no chances with a new consumer on too small a meter, but if an old consumer we judge from size of his bills for a year.

J. H. Enright.

Residence meters should be installed of a rated capacity of one-half to two-thirds of the connected load.

O. J. Bushnell.

Ninety-eight per cent of residences can be taken care of by 10-ampere meters. We do not make a practice of using any meters under 10 amperes, as the saving does not warrant the time lost in trying to ascertain whether a small meter is large enough, and the possibility of putting in a small meter and having same burn out.

F. C. Sargent.

Because of the known ability of standard-type meters to accurately register on 50 to 75-per cent overload for a short time, we install a meter with very little excess capacity over the ordinary load.

E. A. V., A. E. L. Co.

It is practically a matter of judgment, according to the nature of the installation. Fixed rules on this point are of little value.

J. W. Cowles.

Personal opinion.

John J. Gaffney.

Install a meter at the rate of 50 per cent of the connected load. The smaller the meter, the better the results on small loads.

Robt. J. Clark.

We generally place meters of capacity of 50 per cent or less of the connected load in residences. A demand indicator can often be used to advantage in order to determine the requisite capacity of meter.

Geo. Ross Green.

U 16. Should service and house cutouts be fused to same ampere capacity as the meter, assuming that the capacity of the meter is sufficient for connected load? In the event of an overload, will the fuses protect the meter from a burnout?

Yes.

J. A. Lane.

We fuse our meters for 25-per cent overload. Have had no burnouts in three years.

J. H. Enright.

House service cutouts should be fused to the capacity of the connected load, irrespective of the capacity of the meter, as all meters will stand a large overload for a considerable time.

O. J. Bushnell.

Fuses should be slightly heavier than the ampere capacity of meter. They will protect the meter in case of an overload.

John J. Gaffney.

Cutouts can be fused same capacity as meter, since overload capacity of meter will prevent its being damaged before fuse blows.

Wm. Bradshaw.

Fuse service cutouts same ampere capacity as the meter if the total installation is of the same amperage. Fuse house cutouts according to load on each circuit. If there is an overload put on the circuit, fuse will blow before it gets to meter; if there is only one house fuse and it is of the same capacity as the service fuse, an overload will blow that fuse, thereby protecting meter. Meters, however, will stand a 50-per cent overload without burning out.

Robt. J. Clark

House cutouts should be fused with reference to the circuit loads, but service cutouts should be fused practically to the limit of the service capacity, leaving the meter fuses to protect the meter, taking into consideration its overload capacity of fully 50 per cent.

J. W. Cowles.

U 17. What is the best protection against lightning for Thomson meters on a 3-wire, direct-current system?

The fact that the meter frame is grounded will not affect the running of the meter if the current and potential coils are properly insulated.

O. J. Bushnell.

Underground lines are practically exempt from lightning trouble, but overhead lines are always subject to such trouble, from which no satisfactory protection of meters has been found.

J. W. Cowles.

U 18. If the meter is grounded, what effect does it have on the running of the meter? The meter is a 2-wire, type K Fort Wayne. The service being connected to a 3-wire secondary 'bus on pole line, the side to which the shunt of the meter is connected is, therefore, grounded.

If the neutral and the service side of meter are grounded, it will not affect meter; but if the neutral and house side of meter are grounded, the meter will record the amount of current between these two points.

Robt. J. Clark.

U 19. With a ground of 108 volts on house lines and resistance of voltmeter 13,100 ohms, line-voltage 116, how are resistance of ground and loss in amperes computed?

See answer to M 16.

C. E. Skinner.

$X = \frac{R(E-V)}{V}$ where X = resistance to be determined, E = line voltage; V = voltmeter reading when connected through resistance, and R = resistance of voltmeter.

$$X = \frac{13{,}100\ (116-108)}{108} = 970$$

$$\text{Current} = \frac{E}{X} = \frac{116}{970} = 0.11 \text{ ampere}$$

B. J. Denman.

U 20. What has been your experience with direct-current meters for power on 220-440-volt, 3-wire circuits?

Experience with wattmeters on direct-current, 220-440-volt, 3-wire circuit not so satisfactory as alternating-current meters on same voltage.

James Milne.

U 21. Will a recording wattmeter that creeps under no load record the load plus the creep during load period?

Yes.

E. A. V., A. E. L. Co.

The creeping of a meter will not ordinarily affect its accuracy under load, except under very light load conditions.

O. J. Bushnell.

The meter will run a little fast on light load.

John J. Gaffney.

A meter that creeps is usually fast when running under load; it will, therefore, record more energy than is being used.

Robt. J. Clark.

Not under ordinary circumstances.

J. W. Cowles.

No. Meters that creep are often slow on small load.

The Warren Water and Light Co.

U 22. What method is used to determine if the constant marked on meters is correct?

We check revolutions of disc on known load, then prove by running meter on time test.

H. Clyde Parrish.

The accuracy of the constant of a meter dial can be determined by counting the teeth in the gear wheels, thus determining the registration of the dial for each revolution of the armature.

O. J. Bushnell.

It may be determined by test by running a known load for a definite period, or may be determined by figuring the ratio of gears.

J. W. Cowles.

Test the meter.

John J. Gaffney.

Use meters that do not require constants.

Wm. Bradshaw.

U 23. Is there any simple way of determining the strength of a permanent magnet, such as is used in type K Fort Wayne meters?

The relative strength of a magnet may be determined by comparing it with one of known strength from the ratio of speeds obtained by placing the two magnets successively in exactly the same position in the same meter.

J. W. Cowles.

There is no simple way of determining the damping power of permanent magnets.

Wm. Bradshaw.

U 24. What difference, if any, is shown in the action of a meter having a short-circuit in the armature and one having a short-circuit in commutator?

A marked difference, depending upon the number of turns actually cut out.

J. W. Cowles.

No difference whatever.

John J. Gaffney.

Both meters will run slow, but there will not be enough difference to show where the short-circuit is; this can be found by testing with a magneto.

Robt. J. Clark.

U 25. A rotary transforms from direct current to alternating current, and alternating current is used for meter testing. (a) Will meters tested on this current register the same when connected to a main feeding direct from an alternator? (b) If not, what will be the error?

(a) Yes.

J. A. Lane.

Certainly, if the wave-form and frequency of the rotary are the same as for the alternator.

W. A. Carter.

The source of the current furnished should not have any effect on the meters, provided the frequency is absolutely the same, and the wave-form should also be the same. This, of course, would not be true in the case of a rotary converter and the generator, but it should not affect the practical operation of the meter.

M. C. Turpin.

Inaccuracies will probably result, due to frequency and wave-form differences.

J. W. Cowles.

A well-designed induction meter is affected but slightly with a large change in wave-form. It should show same registration for same power, regardless of source.

Wm. Bradshaw.

U 26. How do two meters record the energy on a 3-phase circuit, and how do you figure same?

One meter measures $EI \cos (30° + \theta)$, the other $EI \cos (30° - \theta)$ where E is the voltage between phases, I the current per phase, and θ is the angle of lag (or lead). It must be remembered that there is an apparent lag of 30 degrees between the current in a wire and the pressure between this wire and either of the others at 100 per cent power-factor. Assume a motor drawing 10 amperes between phases at 100 volts. At 100 per cent power-factor the watts are equal to $3 \times 10 \times 100 = 3000$. The current in each wire is $10 \times \sqrt{3} = 17.3$ amperes. The angle of lag in this case is zero, and each meter measures $EI \cos 30° = 0.866\ EI$. Both measure $2 \times 0.866\ EI = 1.73\ EI$ or $1.73 \times 100 \times 17.3 = 3000$. If the power-factor were 0.866 the angle of lag would be 30°, the power in the circuits $3 \times 10 \times 100 \times 0.866 = 2598$ watts. Now one meter measures $EI \cos (30° + \theta)$ $EI \cos 60° = 100 \times 17.3 \times 0.5 = 867$ watts. The other measures $EI \cos (30° - \theta) = EI \cos 0° = 100 \times 17.3 \times 1 = 1730$ watts. Both, therefore, measure 2597 watts.

H. L. W., C. E. I. Co.

Any 3-phase, 3-wire transmission may be considered as a 2-circuit system with common return. Then, if the current coils of two wattmeters be inserted so that one is in each of two of the lines and the potential coils be connected between these respective lines and the third wire, the meters will record the total load. The sum of the two watt-hour-meter records will give the total energy.

C. R. Wylie.

At a power-factor less than 50, one meter runs backward, but the total consumption is shown by the sum of the two readings.

John J. Gaffney.

Two single-phase meters will register the power of a 3-phase circuit correctly, if the algebraic sum of their dial readings is taken. One meter will record greater than the other until 50 per cent power-factor is reached, when one meter will stop and the other register the entire load. Below 50 per cent power-factor, one meter will run backward and the algebraic sum of the meters must be taken to get the correct registration.

Wm. Bradshaw.

Two single-phase meters used on a 3-phase circuit receive the current from two of the wires through their current coils and receive the pressure for the potential coils from these wires and the third wire; the total of the two readings gives results that are theoretically correct.

Robt. J. Clark.

U 27. Will a 3-phase primary wattmeter record correctly when the current transformers are wired so as to use a common return lead? If not, what is the effect of this method of wiring on the operation of the meter?

Yes. The common return will not affect the correctness of the currents in the two current coils of the 3-phase wattmeter.

W. A. Carter.

The registration should be correct; in fact, the method described is quite the common practice.

J. W. Cowles.

This method is correct and is sometimes more convenient to use than the 4-wire method.

Robt. J. Clark.

A 3-phase primary wattmeter will record correctly when common wire is used for the return circuit of the two series transformers.

Wm. Bradshaw.

U 28. When running a 2-phase motor on meter system, will the actual load be registered correctly by connecting a single-phase meter in on one phase and making a constant of 2 to get the total reading?

No. Use two single-phase meters or a multiphase meter.

H. Clyde Parrish.

When a motor is sent from the shop it is practically balanced, hence each phase carries half of the load and one meter reading doubled would give the total reading fairly accurately. A company so metering and being absolutely sure of the correctness of the meter could not, nevertheless, swear in court that such metering was accurate, and for this reason the practice is not recommended.

H. L. W., C. E. I. Co.

There would be considerable chance for error here, as the voltage on the two phases might be unequal.

W. A. Carter.

Yes; one is enough for commercial practice.

M. C. Turpin.

No. Meter might be placed on either high or low phase, which would be unfair to consumer or company. The meter will under some conditions register reversely. If a polyphase meter is not used it is the best practice to install a meter on each phase and take algebraic sum of the registration.

Geo. Ross Green.

Yes, provided the phases are perfectly balanced, but more or less unbalancing almost invariably exists in practice.

J. W. Cowles.

If the ratio of the transformers is the same, the voltage on each phase the same, and the motor windings identical, one meter with the readings doubled will be correct.

John J. Gaffney.

The method suggested is correct only when the two phases of the motor are balanced; an unusual condition.

Wm. Bradshaw.

It is better to use a polyphase meter, as you will then get the total energy consumed. In using a single-phase meter on one phase with a constant of 2, you do not get the correct reading, as the voltage is not likely to be the same and one phase of the motor may be taking more or less current than the other, due to the system being unbalanced.

Robt. J. Clark.

U 29. A meter was tested on a 110-volt circuit with 10-ampere load and was found correct. What is likely to be the error if the meter is connected to a 2200-volt circuit with 300 amperes, using a 20-to-1 potential transformer and 30-to-1 current transformer?

It should be practically correct.

J. A. Lane.

Several errors are possible in the combination. First, the meter should not be larger than 10-ampere capacity, as a larger meter would not register as accurately on extremely low loads. Second, the potential transformer should be of sufficient capacity to avoid any drop in voltage. Third, the secondary voltage of the current transformer should be high enough to overcome the impedance of the series coils of the meter.

L. D. Grim.

If the ratio of the transformers is as stated there will be no error.

John J. Gaffney.

There should be no error on this kind of connection, as meter is being used under practically the same conditions.

Robt. J. Clark.

Meter will register correctly under both conditions. Constant must be used to obtain proper dial reading.

Wm. Bradshaw.

None, provided normal constant of meter is multiplied by 600.

J. W. Cowles.

U 30. Should primary recording wattmeters be tested with their pressure transformers, or may they be tested with sufficient accuracy as secondary meters?

Primary meters may be correctly tested as secondary meters.

H. Clyde Parrish.

For absolute accuracy, primary meters should be tested with their pressure and current transformers. For ordinary test, as secondary meters.

F. C. Sargent.

It is not necessary to calibrate meters with shunt transformers.

Wm. Bradshaw.

It is not necessary to use the transformers when testing primary meters; testing as secondary meters will give the same results. However, the transformers and meters should be checked periodically to be sure that they maintain their correct ratios.

Robt. J. Clark.

Primary meters should at least be occasionally tested with both potential and current transformers, but intervening tests can safely be made upon the meter itself in order to insure its accuracy. The complete-unit tests are desirable in order to avoid any possibility of wiring or transformer changes, which would not be apparent in testing the meter by itself.

J. W. Cowles.

We have tested both ways and do not find any difference.

The Warren Water and Light Co.

U 31. What is the cost, in an average station, of meter repairs and testing?

It costs us about $2.00 per year per meter for installing, repairing, reading and testing same.

United Electric Light Co.

The cost of meter repairs and testing should run from about 75 cents for induction meters, up to $1.50 for commutator-type meters annually per meter installed, depending largely on the conditions of use.

O. J. Bushnell.

One dollar and fifty cents per meter per year. This includes the entire handling of meters; that is, the installation and discontinuance, testing and repairs.

F. C. Sargent.

U 32. In using one recording instrument on several voltages, alternating-current circuit, which would be the better to use on the potential circuit—shunt transformers or non-inductive re-

sistances? What are the advantages and disadvantages of each method?

The only correct way is to use shunt transformers. Non-inductive resistance in series with shunt coil will change wave-form of current in shunt circuit and meter will not read correctly.

Wm. Bradshaw.

U 33. Will there be any difference in the reading if the ammeter of a direct-current machine is in the positive or in the negative lead wire? If so, why?

No.

J. A. Lane.
M. C. Turpin.

No difference, if the circuit is free from grounds.

J. W. Cowles.

With compound-wound machines ammeter should not be on same side as series coil, as some of the current generated in the machine may flow to, or it may receive current from, another through the equalizer.

B. J. Denman.

Not unless there is a dangerous ground on the machine.

W. A. Carter.

U 34. What is meant by power-factor? How does the power-factor of a motor load affect current meters?

By power-factor is meant the ratio of the true power in a circuit to the volt-amperes in the same circuit. Hence, for a given wattage, the lower the power-factor the higher the amperage. Thus 10 amperes at 100 volts and 100 per cent power-factor equals 1000 watts, and 20 amperes at 100 volts and 50 per cent power-factor equals 1000 watts. In the first instance a current meter would register correctly; in the second it would register 100 per cent higher.

H. L. W., C. E. I. Co.

Power-factor is the relation of the true watts to the apparent volt-amperes in an alternating-current conductor or circuit. It has no effect on induction-type meters.

John J. Gaffney.

U 35. How does the Sangamo wattmeter compare with commutator types of meters as regards accuracy on small loads, efficiency and accuracy on overloads, direct current? Is it more likely to be inaccurate when exposed to low temperatures?

We have found the type *D* meter accurate on light load.

E. A. V., A. E. L. Co.

Sangamo wattmeters compare favorably with commutator-type meters as regards accuracy on small loads and overloads. They are subject to about the same temperature error as commutator-type meters and would not be affected by any low temperature in ordinary climates.

O. J. Bushnell.

Mercury-type wattmeters are not as reliable as commutator type on light loads, and not on full or overload if there is any change in voltage.

Wm. Bradshaw.

U 36. What success has the fraternity had with the mercury-floated disc meter?

U 37. How do member companies keep record of kilowatts expended on direct-current series arc circuits? This question is prompted by discouraging experience with arc meters.

We have been operating direct-current series arc circuits for commercial and street lighting for nearly twenty years, and as these circuits are switched on and off at the station, and as all the lamps on the circuit go on and off at the same time, we keep a record of the number of lamps operated on each circuit and the hours of burning. In calculating the output, we multiply the lamp-hours by an average watt consumption per lamp-hour, which is determined and checked up once or twice a year by taking ammeter and voltmeter readings on the circuits at the switchboard.

E. J. Fowler.

Our series arc lamps are adjusted to take 9.6 amperes at

50 volts per lamp, and by multiplying these figures by the number of lamps in circuit the number of kilowatts expended can be readily obtained.

Geo. Ross Green.

U 38. What is a simple and handy way to test interior iron-conduit wiring? Apparatus required to be carried by meter tester along with other instruments and therefore must not be bulky.

For ordinary ground-testing the voltmeter naturally carried by the meter tester should be sufficient.

J. W. Cowles.

U 39. Do you insure service meters? If not, do you charge damage to customer?

We do not insure service meters, and do not see how we could possibly charge any damage to the customer unless he wilfully broke the instrument or in some way attempted to tamper with it.

Bennington Electric Co.

No.

W. W. Titzell.

Service meters are not insured. A customer is charged for damage to a meter only when it is caused by manifest misuse or negligence.

O. J. Bushnell.

We used to oblige our customers to insure their meters, but found that it was very unsatisfactory and caused a great deal of feeling at times on the part of the customer. We abolished this method, as we found that the percentage lost by fire or other causes each year did not warrant any insurance on our part or on the part of our customers.

F. C. Sargent.

We do not insure meters in service, and only charge customers with damage to meters where such damage is caused by consumers' carelessness, and so forth.

Geo. Ross Green.

We insure meters only against fire; any other damage we stand for.

Robt. J. Clark.

No, unless damage was caused by his own carelessness.

C. R. Price.

No insurance, and no attempt to charge customer for any apparatus damaged by fire.

J. W. Cowles.

U 40. Do you require a deposit, or a guarantee to cover the credit extended to tenants, and, if so, do you accept the guarantee of any responsible party, or the guarantee of the tenant's landlord only?

Not where applicant's connection with a responsible firm can be established. In cases of tenants of apartment houses, we locate their business connection and base our action accordingly.

Frank W. Smith.

We do not require a deposit from customers who are property owners. We do not accept guarantees.

F. C. Sargent.

In case of a tenant we require a deposit; if a property owner, we do not.

Robt. J. Clark.

A new customer pays $4.00 as a deposit for an approximate monthly bill in a residence, and from that up to $15 or $20 for a store. This draws interest at five per cent for time kept. We pay it back in a year if account has been kept good. We do not believe in guarantees.

C. R. Price.

Cash deposit or security from a reputable person is required where applicant has not a creditable standing.

The Pueblo and Suburban Traction and Lighting Co.

U 41. When a meter man tests a meter, what information is it advisable to give the consumer?

If consumer desires to know, he is entitled to the truth.

J. H. Enright.
J. A. Lane.

Absolutely none other than a statement to the effect that a detail report will be sent from headquarters.

Frank W. Smith.

We believe the meter man should say very little to the customer in regard to the test he may make, but we also believe the office should be perfectly frank with the customer and explain to him everything about it.

Bennington Electric Co.

A meter tester should not give a customer any information whatever in regard to the meter he is testing unless the test is made by previous appointment with some representative of the consumer; otherwise the consumer should be referred to the office for any information desired.

O. J. Bushnell.

We think it is not advisable for the meter men to give the customers any information in reference to tests. While this might be given in good faith, it is possible that it might conflict with the information given from the office, and if it should it would cause undue suspicion on the customer's part that there was something crooked.

F. C. Sargent.

By all means refer the consumer to the main office for information.

John J. Gaffney.

The meter man should report at the office, and it should be part of the duties of one clerk to communicate with the complaining customer.

C. R. Price.

None. Consumer should be politely referred to the office of the company for all information.

Geo. Ross Green.

Show the customer the actual record of the tests.

M. C. Turpin.

Unless by special appointment with a representative of the consumer, the meter reader should not give any information. Let the office write to the customer and *tell the truth.* If the meter was fast, say so; don't lie about it. The discovery of a fast meter will not frighten your customer; in fact, your acknowledgment of the error will do good the next time you have to report one as being slow.

E. C. Stahl, Jr.

He is instructed to evade all questions and to refer the consumer to the office, where we always show a copy of the test if desired.

The Pueblo and Suburban Traction and Lighting Co.

Meter tester should avoid giving the customer the impression that he has anything to withhold, but should refer all inquiries to the office in order that information desired by the customer may be given officially and in a uniform manner.

J. W. Cowles.

It is advisable to give to customer such information as is necessary to answer the customer's questions, and all information given should be marked on the report of the meter test, for the information of the person handling the complaint or other question that gave rise to the test.

Douglass Burnett.

The meter man is not usually a diplomat in close touch with the reasons why the meter is being tested, therefore he should give the customer no information whatever regarding the results of the test, but should refer him to the office.

F. Ellwood Smith.

U 42. What do you consider the most satisfactory explanation to make to a consumer regarding the use of constants in computation?

Explain that constants are used to keep the size of meters the same for various capacities.

J. A. Lane.

Most customers will readily understand that the use of a constant is necessary in large-capacity meters, in order to avoid too high a speed of the rotating element or an excessive amount of gearing.

O. J. Bushnell.

It has frequently been possible to explain a constant to a consumer in the following manner: He is shown on page 51 of the General Electric Company's catalogue No. 3197 that the revolutions per minute of the 7.5-ampere and the 15-ampere, 220-volt, 3-wire Thomson recording wattmeters are each 27.5 revolutions, or 1650 per hour, at full load. If 7.5 amperes at 220 volts are passing through the meter for one hour, then 7.5 × 220 = 1650 watt-hours; therefore, one revolution of the disc of the 7.5-ampere meter is equivalent to one watt-hour. In the case of the 15-ampere meter it will be seen that 15 amperes for one hour at 220 volts equals 3300 watt-hours, or one revolution of the disc is equivalent to two watt-hours. Inasmuch as the dial mechanism of these two meters is exactly the same, it would follow that the dial indication of each would be the same, namely, 1650—although double the amount of energy has passed through the 15-ampere meter as through the 7.5-ampere meter. It is therefore necessary to multiply the dial reading of the 15-ampere meter by the constant 2 in order to obtain the correct amount of energy.

Consumers have also been able to understand constants by drawing a comparison with a bicycle cyclometer. The dial mechanism of the meter is really a device for recording the revolutions of the bicycle wheel. Each revolution of the disc of the meter is equivalent to a certain number of watt-hours, just as each revolution of the bicycle wheel is equivalent to a certain definite fraction of a mile. It would therefore be necessary to know only the number of revolutions and the value of one revolution, and multiply the number of this value (constant) in order to obtain the correct amount. The meter is usually calibrated in watt-hours or kilowatt-hours, just as the cyclometer is usually calibrated in miles.

The Philadelphia Electric Co.

We explain to the consumer that the constant is used by the manufacturer so that the same parts can be used for meters of different capacities.

The Pueblo and Suburban Traction and Lighting Co.

A customer should be made to understand that without the use of a constant the size of the meter would depend on the size of the installation, and meters are made with different constants so that the meters may remain of practically the same size for the different amounts of current they have to handle.

Douglass Burnett.

That the use of constants is to reduce the speed of the meter.

John J. Gaffney.

"Eliminating all technical terms, we have found the following brief explanation and comparison to be of service in dealing with the question directly with the customer:

"'A too rapid movement of the disc in the meter would introduce mechanical troubles, as there is a speed limit to any mechanical construction. To insure a long life of the jewel bearings, the disc should not make over 50 revolutions per minute at full load. The disc of a 60-light meter makes exactly the same number of revolutions per minute, at full load, as does the disc of a 30-light meter. It is, therefore, evident that while the dial will record at full load exactly the same amount as will the dial of a 30-light meter at full load, yet double the energy has passed through the 60-light meter, and therefore, in a 60-light meter, the dial reading must be multiplied by 2 to get correct consumption. All current consumed passed through the meter. The dials record in inverse ratio to the constant. For these mechanical reasons, and to reduce the manufacturing cost, the meters and dials are built of standard sizes, with proper calculations for the proportional amount of current registered, which accounts for the use of the constant.'

"The following suggestion has been made by one of the experts of the Lynn factory: That 'we make the comparison with a pair of beam scales, on which we use the different weights, such as 1, 2, 3 pounds, and so forth, the arms or levers remaining standard, and the size of the weights varying with the load.' " [Proceedings of the Association of Edison Illuminating Companies, 1902.]

Editor.

U 48. What is the best method of securing the people's confidence in electric meters?

Teach them to read their meters and to figure their own bills correctly.

J. H. Enright.

A very nearly impossible condition, but we have a glass-case meter in the office with graduated disc, so connected up that we can turn on any number of lights, and we are always glad to have any customer examine the meter and play with it all he pleases. We mean to be perfectly frank and to take all the time necessary to explain to our customer what we know about the instrument.

Bennington Electric Co.

By test of meter whenever required and, if not satisfied with this, an offer to allow customer to call in an outside expert, the company to pay the expense if conditions are found other than already reported by the company.

Frank W. Smith.

The more correct information a customer has about his meter and his service, the more easily he is satisfied; the less a customer knows, the more difficult he is. Give him instructions how to read his meter, show him how to test it by turning on one lamp, then another, then several, and so on, up to full load. Show him that the meter will not "go round" when no load is connected. Be sure your meter is correct, and if you can not satisfy him as above, suggest to him that he get some competent outside party to test it for him.

W. T. Titzell.

Good meters and a careful inspection, with honest reports in case any trouble does develop.

E. C. Stahl, Jr.

All questions are freely answered. We especially encourage consumers in reading their meters themselves.

The Pueblo and Suburban Traction and Lighting Co.

Whenever a radical change takes place in the amount of the monthly meter reading, some one should go to the premises and inquire if there has been any change in the use of current; and to this end every bill rendered should be examined as to reasonableness, by comparing the amount of current consumption shown on the meter with that for previous periods. Comparison should also be made, in the event of question, with the record of the same month of the previous year. The chief bookkeeper should then order a test of the meter, if it appears to him desirable. With these precautions, inquiries or questions from the customer can be intelligently answered in the event of question being raised, and the company will have the assurance that its bills are being rendered correctly. Meters should be tested at regular intervals of, say, not less than once a year, or once in one million revolutions of the armature. The customers' bills should contain from time to time, particularly in the autumn months, instructions on reading meters. Very large customers using current for business purposes should be requested to take their own meter readings at the opening and at the closing of each business day and to figure out the current consumption for each of such periods; any change in the meter reading will thus be checked up almost as soon as it takes place, and abnormal conditions, such as heavy Saturday-night burning (if the readings are taken at a certain time each afternoon or evening), will be understood. Special meter tests should be made when a customer's complaint, after investigation, shows the advisability of such a test. Meter tests should not be taken at random, because in such cases they serve to discredit the company's opinion of the meter, and the customer is dissatisfied when a test has been ordered and the meter is found correct.

As a result of these various ways of handling the matter, the customer will be satisfied with the meter as being intelligently handled.

Douglass Burnett.

By the side of every meter have a card giving instructions how to read the meter. Urge customers to read the meter often themselves and to keep track of their consumption, checking the meter with the lights used each day and making a record until they are satisfied the meter is correct. Have a meter in the office in a glass case and show its working to customers.

F. Ellwood Smith.

A painstaking effort to show the customer a meter working under a known load.

C. R. Price.

The best method for securing the people's confidence in electricity meters is, first, to keep them accurate by a thorough and systematic system of testing, and, second, to educate consumers to read their own meters.

O. J. Bushnell.

U 44. Would it be advisable to have booklets printed to distribute among consumers, explaining electric meters?

This would be a good work for some of the advertising companies to undertake; every station would want a supply.

C. R. Price.

We think so, as a matter of education. For, the more mystery with which we surround our meters, the more the consumer is likely to kick.

E. A. V., A. E. L. Co.

It is unquestionably advisable to distribute to customers printed matter explaining the method of reading their own meters and figuring out their bills.

O. J. Bushnell.

It would. For the smaller companies such a booklet might be got up by some advertising company on the syndicate plan.

E. C. Stahl, Jr.

Yes, decidedly so.

The Pueblo and Suburban Traction and Lighting Co.

The practice of supplying to customers printed instructions on the reading of indicators and computing of bills has been found advantageous, but any detailed explanation, either technical or otherwise, of the working of the meter would probably interest very few of the customers.

J. W. Cowles.

It is preferable to handle the situation as shown in reply to U 43, and to have the customers understand that a competent person will call upon them and explain how to take meter readings, on request.

Douglass Burnett.

It would be a good thing.
See U 43.

F. Ellwood Smith.

U 45. In case you are using one make of meter and you have a customer who desires you to change it and put in another make of meter, do you do this, and, if so, at what expense to the customer?

We should prefer to keep only one make of meters.

C. R. Price.

Give him the meter he desires, if possible, and satisfy him.

J. A. Lane.

We change meter without expense to the customer.

H. Clyde Parrish.

If we could not convince the customer that the meter we are using is the best obtainable, we should probably buy for him the meter he desired; if he were a large customer, should do so without expense to him.

Bennington Electric Co.

We never install a meter of a different make from that ordinarily used, but when it seems advisable to change a meter at the customer's request, it is done at the expense of the company.

O. J. Bushnell.

We only install types of meters we have selected as standard, and if consumer wishes one of these types changed for another that we use we will change same, if customer has any logical reason for request, at no cost whatever to the consumer. Of course, in all cases of this kind the matter is taken up with the consumer and an effort made to prove to him that we have selected the most efficient type of meter for his installation.

Geo. Ross Green.

We invariably test our meters in service and are very reticent about substituting other meters if the meter is found to be correct, as in most cases it would serve as an admission that the meter in use was incorrect.

The Pueblo and Suburban Traction and Lighting Co.

Any reasonable request on the part of the customer would be complied with, as far as possible, without expense to him.

J. W. Cowles.

U 46. How shall we treat a consumer when we feel that his bill is too high, although the meter and wiring are correct by test?

Good-natured, convincing argument, and an invitation to an exhibition test of his meter with fixed load.

C. R. Price.

Explain that it is absolutely correct and ask him to pay the bill. Such a condition should not exist.

J. A. Lane.

We often save a customer money by going over his lighting installation and re-arranging the lights or changing the shades. We have found customers burning 24-cp lamps where an 8-cp lamp would be sufficient, and in one residence we recently changed quite a number of 24-cp lamps to 16-cp, using Holophane shades and obtaining in this way a good deal more useful light.

Bennington Electric Co.

In some cases the writer believes it good policy to allow a moderate arbitrary rebate, stating distinctly that it is not done because of any question of the correctness of the bill, but rather because it is felt that a certain amount of give and take is better for all parties.

Alex. J. Campbell.

The way a customer should be treated when his bill seems too high and tests prove that the installation is correct, can be handled in many ways. One man can be told that everything indicates that his bill is correct, and he pays it and is satisfied. Another could never be satisfied, but instead of giving him a rebate, wire a light free for him or give him a cheap reading lamp. A rebate to him spreads to the other customers, and they expect, and rightly, that they are entitled to a rebate. When the tests prove that the meter and installation are correct, we should never feel that the bill is too high.

Wm. M. Lewis.

As this would probably be an arbitrary adjustment, no set rules could be laid down, as different conditions would no doubt have a great effect on the settlement.

Geo. Ross Green.

We do not leave him until we find the trouble. We seldom or never fail.

The Pueblo and Suburban Traction and Lighting Co.

We can hardly expect to convince a customer on a point on which we are not positive ourselves, but if careful tests have proved the meter and wiring to be correct beyond all question, we should then endeavor to convince the customer by means of the same arguments that have convinced us. All doubt in our own minds should first be eliminated before endeavoring to treat with the customer.

J. W. Cowles.

U 47. Where the ordinary load is only a small portion of the connected load, as in a residence, if the capacity of the meter

installed is based on the average load, how do you overcome the objections of the underwriters or municipal inspectors?

Satisfy underwriters or municipal inspectors by making a test of the overload capacity of the meter.

Wm. Bradshaw.

Underwriters and municipal inspectors leave the size of meter to our judgment.

P. C. Oscanyan.

U 48. What municipal or other governmental regulations are imposed with regard to accuracy of consumers' meters? This company is required to correct all meters, when tested, to within one-half of one per cent on full load, one per cent on half load, and two per cent on one-quarter load, but is not required to test at any stated interval. Is not the above requirement very strict?

The only part of requirement that is too close is the 0.5 per cent on full load.

Wm. Bradshaw.

We are not troubled with the above conditions, but I think the rules are too strict and should be objected to. A very fair test to both consumer and company is as follows: Two per cent on full load and five per cent on light load (that is, 10 per cent of the rated capacity of meter); no test at intermediate points.

Robt. J. Clark.

County of London "Electric Lighting Acts and Orders" contain the following clause:

"In the case of meters which, before being fixed, shall have been tested by the council and passed as correct meters, the meters will be tested for starting current and at one or more quarter loads, and if the results be approximately the same as those obtained in the previous tests the meters will be considered correct. A meter shall be considered by the inspector to be a "correct" meter if, being intended for currents (a) not exceeding 3 amperes, the error at one-tenth of its full load and above this point does not exceed + or — 3½ per cent, (b) exceeding 3 amperes but not exceeding 50 amperes, the error at one-tenth of its full load and above this point does not exceed + or — 2½ per cent, and (c) exceeding 50 amperes, the error at one-twentieth of its full load and above this point does not exceed + or — 2½ per cent."

Editor.

Under the laws of the Commonwealth of Massachusetts a meter is considered commercially correct if it does not vary more than five per cent from the standard. The practice of a company should, however, be based upon a lower range, two per cent being a reasonable working basis.

J. W. Cowles.

Massachusetts law provides for meter tests under the direction of the Board of Gas and Electric Light Commissioners. A meter is considered correct if it is within five per cent of the standard.

F. Ellwood Smith.

U 49. What city or state legislation is extant, protecting an electric company in removing a meter that has been tampered with, when the company can not prove that the consumer himself "fixed" the meter?

If in a residence, the consumer is responsible for the meter. If in an accessible public place, it would be different. We have had to stand for prepayment gas meters broken into in such places, as it is difficult to fix the blame.

J. A. Lane.

U 50. Where the commercial end of a company is under one management and the operating under another, should the meters be read from the commercial office or from the meter department—the meter department being under the operating superintendent? Why?

We have found it advantageous to have the meters read by the meter department, which is under the operating superintendent. The customer's consumption is also figured in the meter department, and the amount of kilowatt-hours is sent to the auditing department to be billed. The following are some of the advantages obtained: A trained meter-man checks all meter readings and the amounts of consumption, having at hand the data of the meter tests to assist him in judging the accuracy of the figures. Investigations of variations in consumption or of defective meters are made by an inspector in the same department, reporting directly to the checker. The meter records are all kept in the meter department, where the record of the readings is necessary to properly determine the frequency with which meters should be tested.

O. J. Bushnell.

The reading of the meters should be done by the operating department rather than by the commercial or accounting departments, in order to put the entire handling of the meters under one head and to have all men entering customers' premises in any way relating to the meters under one authority. To do otherwise occasions divided responsibility, always to be avoided. By handling the readings through the meter department certain information is available and better oversight is possible.

The Edison Elec. Illg. Co. of Boston.

In a plant of 4000 meters it will take three men at least six days to read meters. If these men are taken out of the meter department for that time it very badly cripples that department and does not give it a fair show for a good month's work. I believe that meters should be read from the commercial end and I think the best plan, if the company is large enough, is to have men that do nothing else but read meters. In a plant of 5000 meters one man reading every day can take care of this work very nicely.

Robt. J. Clark.

U 51. Has any one observed a meter running slow after a short-circuit?

We have never found a meter that ran slow after a short-circuit due to the strengthening of the magnets, but sometimes a meter will be slow after a short-circuit due to the fields being drawn in on the armature and breaking some of the leads.

O. J. Bushnell.

Have never known a meter to run slow unless the armature or commutator was damaged. Sometimes a heavy short-circuit will break in the commutator leads or open the armature and then the meter will run slow. A short-circuit on an induction meter will generally make it run fast, as there is no armature or commutator to be damaged.

Robt. J. Clark.

Yes, in cases where the armature has been damaged or the winding ruptured.

The Edison Elec. Illg. Co. of Boston.

U 52. Does the right-angle arrangement between the field of the series coils of meters and the permanent magnets protect them, and to what extent?

The right-angle arrangement between the field of the series coils of the meter and the permanent magnets undoubtedly protects them to some extent, although not entirely. In old-style meters, with magnets in different positions, it is invariably found that the magnet in this position is the least affected by short-circuits.

O. J. Bushnell.

Yes, undoubtedly; but to just what extent is hard to say.

The Edison Elec. Illg. Co. of Boston.

U 53. What has been the experience of meter-men in observing the deterioration of the permanent magnets in meters?

The deterioration of permanent magnets in meters has been observed as follows: First, a slight loss of magnetism, due to the aging of the magnets. Second, a larger loss of magnetism, due to the meter operating on a considerable overload. Third, a great deterioration, due to the effect of short-circuits, which weaken one pole of the magnets.

O. J. Bushnell.

Meters will sometimes be found two or three per cent off on heavy loads when well cleaned and all working parts in good condition, but it is doubtful if this can be laid to the deterioration of the permanent magnets.

This is a very hard thing to discover, and when the magnets lose their strength I believe it can be accounted for by frequent short-circuits passing through meter. I do not know of any case in my experience where I can place trouble with magnets to deterioration.

Robt. J. Clark.

Certain meters have shown a marked tendency toward deterioration of the magnet, due to improper or insufficient aging by the manufacturer.

The Edison Elec. Illg. Co. of Boston.

V—ADVERTISING

V 1. What percentage of income per year may profitably be spent for advertising by an electric company?

Impossible to put advertising expenditure on percentage basis. This question should be governed entirely by local conditions.

Percy Ingalls.

The amount of percentage depends upon the territory to be worked as well as upon the expenditure that can be assigned for the purpose.

C. C. Gartland.

Four to five per cent.

B. J. Denman.

We have spent for the past three years two per cent of our gross receipts, with very satisfactory results.

P. H. Korst.

V 2. State the percentage of direct replies to advertising, for one year, as compared with number of inquiries sent out.

Very small indeed—practicably negligible.

Alex. J. Campbell.

Varies from nothing to five per cent on circulars, average probably one per cent. Nothing to 20 per cent on letters, average about three per cent.

Frank C. Farrar.

V 3. How do you compile your mailing lists, and what method do you pursue in keeping them up to date?

We make up our mailing list from the better class of people in the city directory and revise the list every few months. This being a small place, we know almost every one on our list.

P. H. Korst.

From solicitors' canvass books, checked every two weeks.

Frank C. Farrar.

Mailing lists should be made up from card record of prospects, and should be revised each month as corrections are made in card records.

Percy Ingalls.

First, include all the customers connected on the line, with the exception of some who you are positively certain will not be interested in any information you may have to send them. Second, procure a city directory and take therefrom the names of the inhabtants residing in the better parts of the town. This should be gone over at least once a month, and any changes should be noted. Enlist the help of the wiring contractors, securing from them the names of all houses recently wired; also secure from the building contractors locations of all new houses.

M. C. Turpin.

V 4. In a follow-up system, which do you consider the better policy—frequent communications of average workmanship as to printing, design, and so forth, or fewer communications of higher grade? How often each month or year would you circulate a given list?

Frequent communications of good workmanship and, if necessary, a smaller list of prospects.

Percy Ingalls.

Would prefer frequent communications of average workmanship rather than the higher grade sent out at less frequent intervals. Such communications should be sent out not less frequently than once a month.

M. C. Turpin.

We think few communications of a high grade pay better than a lot of cheap stuff. Some of the advertising matter we have used this year has cost $1.50 per article.

United Elec. Lt. Co.

When first starting advertising, frequent communications. Gradually improve quality and decrease quantity—not too far, though.

Frank C. Farrar.

V 5. How much per capita of population in your territory did you spend on advertising during 1906?

Eight cents per capita.

P. H. Korst.

Ten cents.

Frank C. Farrar.

V 6. What, in your opinion, is the best method of advertising for the central station with a limited appropriation; in other words, if an appropriation of from $5,000 to $15,000 were made, would you spend it in newspaper, follow-up or street-car advertising, and why?

Divide the appropriation equally. However, if one way of advertising in your city gives better results than others, use your appropriation in that way. Do not, under any circumstances, place advertisements in street cars where the passengers face the front of the car instead of riding sidewise. A good follow-up system is the best of the three, but it must be good.

C. A. Hutchings.

Half newspapers, half soliciting, as reaching the most people most frequently and most intimately.

C. R. Price.

I would appropriate one-third for newspaper advertising as a means for educating the public, the balance on printed circulars outlining specific propositions sent to interested prospects.

E. R. Davenport.

Follow-up system, with a reasonable amount of newspaper advertising judiciously used.

M. C. Turpin.

The best method of advertising for central stations is a combination of newspaper and street-car advertising, backed up by intelligent work of solicitors. In obtaining power business, we advertised that for moderate-sized motors we would install them on 60 days' trial and take them back at the end of that time if they were not satisfactory in every way. We have not as yet had any motors returned. We think this is good advertising.

R. N. Kimball.

After an experience of several years with newspaper advertising, we are prepared to say that we consider the newspaper the poorest medium that an electric light company can use. Nothing can equal personal solicitation, and if we had $15,000 to spend we should use it in paying for high-grade representatives who know how to keep an old customer satisfied and through a satisfied customer get new ones.

United Elec. Lt. Co.

We use newspaper and programme partly as policy and partly for results. We get best results from a monthly bulletin sent to every customer and to a mailing list of good prospects.

P. H. Korst.

Newspapers and follow-up are so essential that every effort to use both should be made. Local conditions, such as size of city and number of solicitors, should also be considered.

Frank C. Farrar.

The follow-up campaign of advertising, properly conducted, will no doubt bring the best results.

Percy Ingalls.

Newspaper advertising. In no other way are you more likely to reach so great a number of prospects for the amount of money expended. This line of advertising is most productive when carried through the evening paper, which reaches a larger number of prospects at a time of day when the lighting question and what you have to say attract most attention, and prepares the way for mail advertising and the solicitors.

C. C. Gartland.

V 7. How do you check up the results of newspaper advertising? Do you look upon newspaper advertising for the central station as a measure of policy or as furnishing a direct return; or do you think it is partially one and partially the other?

Do not believe you can get direct results from newspaper advertising. It is principally of educational value.

E. R. Davenport.

We think it practically essential to advertise in the local newspapers, for the purpose of patronizing them if for no other reason. It is essential to keep in their good graces.

M. C. Turpin.

We find newspaper advertising very hard to check and have offered special prices on certain articles to customers bringing in the advertisement. We think that indirect returns are worth more to the company than direct returns.

R. N. Kimball.

I do not believe the result from newspaper advertising, other than the good will of the editor or proprietor, can be checked up; of course, in stating this I do not want to convey the idea of good newspaper advertising not being worth while, as we use it ourselves and take chances on the result.

J. H. Enright.

(a) By keyed advertisements occasionally, and by checking returns on specialties advertised. (b) We use it for direct returns, but we believe it has value as a matter of policy. This has no effect upon our policy, however.

Frank C. Farrar.

That newspaper advertising doesn't pay is usually the cry of the company advocating direct-by-mail advertising and the man who has tried "advertising" by running a 4-inch single-column advertisement for six months without change in an obscure corner of the village weekly.

Newspaper publicity pays better for some things than for others. It will pay for selling flat-irons and other household devices and for convincing the house owner that he should wire his home for electricity. In short—to reach the home, use the newspapers.

E. C. Stahl, Jr.

V 8. State the proportionate cost of each subdivision of your advertising account—such as newspapers, follow-up advertising, street-car advertising, miscellaneous.

Fifty per cent newspapers, programmes and miscellaneous.
Fifty per cent bulletins every month.

P. H. Korst.

Newspapers, 0.30; follow-up, 0.54; street cars, 0.06; billboards, 0.03; miscellaneous, 0.07.

Frank C. Farrar.

V 9. What general or specific rules do you follow in the matter of making investments for installation incident to getting new business? Please divide your answer as follows, stating method in each case: (a) Do you make free sign installations? (b) Do you make free motor installations or do you make use of a loan proposition? (c) Would you make the investment necessary to change an elevator from hydraulic to electric? (d) Do you do any wiring free of charge (residences or stores)? Do you supply first installation and free renewals of special lamps, such as the high efficiency and Nernst lamps? (e) In shutting down isolated plants do you aid in financing the electric installation, and how?

As a general rule, we do not furnish anything free, but make our new customers pay for everything they want at about cost. When necessary, however, we arrange an easy-payment plan.

Ludwig Kemper.

(a) No. (b) Yes. We install motors free and sell them at cost. (c) No. It is very difficult to make any money out of the average electric-elevator customer found in small cities. (d) No. (e) To the extent of furnishing installation at cost, yes.

J. H. Enright.

(a) We find it much more satisfactory to sell signs than to put them out on a rental basis.

(b) We install motors free for 60 days' trial on contract.

(c) We have recently changed several hydraulic elevators to electric. The customer made the necessary investment.

(d) We do not do any wiring free of charge, and we charge for the first installation of all lamps.

(e) We do not aid in the financing of electrical installations or replacing isolated plants except when we make contracts letting customers pay for their apparatus on the instalment plan.

R. N. Kimball.

(a) Yes. (b) Large motors are sometimes rented, small ones are always sold. (c) No. (d) Yes, in case of competition

The Pueblo and Suburban Traction and Lighting Co.

(a) Yes, but we do not push it; believe the customer sticks better when he has money invested in a sign. (b) We make a loan proposition whenever necessary. (c) Would depend on the return in sight. (d) No free wiring. Free renewals, but not free first installation.

P. H. Korst.

(a) We make free sign installations, charging the customer a flat price per week, we turning the lights on and off. We make contracts for 4-hour or 6-hour burning or all-night service. Sign contracts are made for two years. The signs are our property. In case the contract is not renewed at the end of two years, we remove the sign.

(b) We do not make free motor installations, nor do we loan motors. We do not think this advisable. We adopt a very liberal policy in connecting up motor installations for a short period, in order to demonstrate the reliability and cheapness of our service. In some cases we have loaned a motor for two months to make such a demonstration.

(c) We do not change hydraulic elevators to electric free of charge. The income from elevator service would not warrant making such an investment.

(d) The only free wiring we do is for flat-rate arcs and signs. We make a concessional price of $1.00 per lamp for window lights, and make a contract for one year, asking a guarantee of 25 cents per 16-cp lamp per month income. We make free installations of standard lamps, 4-cp to 100-cp; also standard arc lamps, but no free renewals on special lamps.

(e) In shutting down isolated plants, we very often buy the apparatus at a price close to the second-hand market value of such apparatus. We have made time contracts on the installation of electrical apparatus, the customer paying so much a month until the apparatus was paid for, charging interest on this investment at standard rates.

E. W. Lloyd.

In general, we do not believe in making any investments in securing new business except that necessary for line extensions. Customers are more likely to appreciate a thing that they have to spend money to secure.

(a) We have no trouble in getting customers to buy signs.

(b) Customers have to spend money for any kind of power equipment, and motors are cheaper than any other motive power. Then why make free motor installations or loan motors?

(c) By no means.

(d) This is unnecessary. Customers can be obtained at a much less cost by proper solicitation.

(e) We do everything possible to assist our customers in connecting up to our service.

B. W. Mendenhall.

V 10. Do you employ women for soliciting in the residence district? If so, are they successful, and why?

Women solicitors for special canvassing, particularly in the residential districts, can get a hearing far quicker than men.

C. A. Hutchings.

Have employed one woman solicitor with success, after having taught her the business.

The Pueblo and Suburban Traction and Lighting Co.

For sale of flat-irons only.

F. Ellwood Smith.

We do not employ women as solicitors. Ordinarily, I believe the prospective customer does not have as much confidence in the ability of a woman solicitor as in a man, and they can not be promoted so rapidly or advantageously.

D. R. Pierson.

Women are the best demonstrators for heating appliances and may also be employed successfully in soliciting residence lighting.

Percy Ingalls.

V. 11. How often do your solicitors meet for general conference, and how freely may they discuss existing conditions at such conferences?

Our solicitors meet every morning for about fifteen minutes, make their reports on the previous day's business, and ask questions of the head of the business-getting department about particular cases they have in hand for the day. We also have a monthly meeting, at which any agent has the privilege of asking questions on any subject pertaining to the business. We also have papers and discussions on different subjects pertaining to the business. At these meetings, generally speaking, the discussion is open, and any point regarding the getting of business is discussed freely with the solicitor.

E. W. Lloyd.

Every morning, from 8:15 to 8:45, for general conference, and one evening a week for educational purposes. Existing conditions are very thoroughly and freely discussed.

S. A. Sewall.

V 12. Describe briefly your follow-up system for checking solicitor's work.

The solicitor makes out a report card for each call, giving the name, address, result of call, and other data. If it is not possible to secure the business at that time, a note is made in "tickler" giving the date to call again. The "tickler" is arranged according to the days, months, and so forth. Each morning the solicitor is given some calls to make which have been taken from the "tickler."

E. R. Davenport.

Each solicitor's orders for connections and disconnections are listed on a blank with columns for the different classes of business, such as incandescent, arcs, motors, and so forth. The footings at the end of the month show his net results.

The Pueblo and Suburban Traction and Lighting Co.

It is a very difficult matter to introduce a perfect follow-up system in a very large city, as there is such a constant demand from new sources for information regarding light and power that often prospective customers are overlooked in the rush of taking care of customers who are willing to sign contracts immediately. In a small or medium-sized city a follow-up system could be installed that would be of more value. The solicitor could make a report each morning of the prospects called on.

This report could be kept in a card file and the clerk could remind the solicitors from time to time of the existence of the prospect, and in that way get a percentage of this business which would otherwise be lost.

E. W. Lloyd.

V 18. Do you divide your territory, giving a stated section to each solicitor, or do you permit each to extend his work in whatever direction he can secure contracts?

Divide territory, but when a solicitor has worked his own territory thoroughly—and you can decide this by the reports—and there are certain people who have given you no business, switch another solicitor on to them. His ways may be just to their liking, his talk more in line with their talk, and he may land the order where the other man never could. This has been tried and found to be true.

Wm. M. Lewis.

Divide territory, giving each solicitor a stated section, and do not allow him to work outside his district.

E. R. Davenport.

Territories are divided.

The Pueblo and Suburban Traction and Lighting Co.

Depends upon the territory. In cities it is probably better to give solicitors certain districts.

Percy Ingalls.

Solicitors are given certain territories.

F. Ellwood Smith.

We divide the territory, but permit solicitors to bring in business from other territory with the consent of the solicitor in charge.

P. H. Korst.

We divide our city into sections, and each power, light and sign solicitor has a given territory in which he works exclusively. There may be a power, a light and a sign solicitor in one district.

E. W. Lloyd.

We divide our territory, giving the representative a business and a residence territory, the representative to have charge of the two divisions, but devoting most of his time to the business territory, the residence being taken care of by an assistant representative. However, the representative spends some little time on the residence territory.

Frederick Harry.

V 14. Do you allow commissions to architects, engineers, builders, for wiring or motor contracts, and on what basis? If so, does it aid you in securing new business, and to what extent?

No.

P. H. Korst.
The Pueblo and Suburban Traction and Lighting Co.

No. We sell to architects and builders at a lower price than to the ordinary customer.

R. G. Gentry.

We believe commissions to architects, and so forth, are unnecessary.

Percy Ingalls.

Commissions could be allowed; those who become interested are advertising mediums and can influence installations.

C. C. Gartland.

We allow builders 10 per cent of a wiring job.

C. R. Price.

V 15. Into how many branches is your soliciting department divided? Name them, prescribing the duties and limitations of each branch.

Our soliciting department is divided into two main branches—advertising and personal solicitation. It is the duty of the advertising manager to keep the name and the product of the company before the public in a general way and specifically introduce to the individual certain uses for gas, electricity and appliances. On the personal-solicitation end we have the representatives, who are regarded as general managers of individual territories. They have personal charge of the soliciting work, also complaint work; seeking by adjusting complaints to gain additional consumption or sell additional appliances. Then we have the assistant representatives, who do the detail work at the instance of the representative and attend to the residence territory, the representative having especial charge of the business territory. Then we have the women demonstrators, who call on our consumers and explain the use of our appliances. The service supervisors seek to increase the consumption on present appliances installed and to introduce new appliances. The duty of the special men is to take charge of the special line in which they are engaged and to assist the general representative and assistants in their individual territories.

G. M. Karshner.

Three branches. Lighting bureau, in addition to soliciting lighting business, also has sales of small motors (less than 1-hp) that are connected on lighting rates, and domestic heating appliances, but makes no extra effort in the latter case. Heating bureau solicits strictly heating goods, both domestic and industrial appliances. Power bureau solicits for power business only.

E. R. Davenport.

V 16. What is the average yearly salary of your solicitors (not including heads of departments)?

Twelve hundred dollars.

E. R. Davenport.

We pay our solicitor $60 per month and guarantee him work all the year around. We find that local men like this basis better than the percentage basis when they make more at certain times of the year.

R. N. Kimball.

Ten hundred and twenty dollars.

The Edison Elec. Illg. Co., West Chester, Pa.

V 17. How many solicitors do you employ per 1000 customers? State number whose work is wholly soliciting and number who have mixed duties.

One. His duties are wholly soliciting.

The Pueblo and Suburban Traction and Lighting Co.

Two solicitors per 1000 customers. They also do meter reading and collecting.

P. H. Korst.

We have one solicitor to about every thousand customers.

E. W. Lloyd.

A good, live solicitor weighted with encouraging salary and commission conditions should handle about 5000 customers.

C. C. Gartland.

V 18. What is the average cost of soliciting per kilowatt-hour sold, charging to this account all expenses for securing new business, except advertising?

V 19. How may the efforts for the encouragement of electric installations in buildings about to be erected be improved, and what standard line of action should be followed?

Cultivate the acquaintance of the architect and building contractor; incidentally, call upon the owners.

C. C. Gartland.

Advertise, then advertise, and then advertise again. Personal solicitation with the builders and contractors would be very effective.

R. G. Gentry.

V. 20. What kind of advertising do you consider the most effective, and the best for the company to adopt?

Newspapers, and the backs of the company's bills.

C. R. Price.

Local conditions should govern the inaugurating of a system, which in the majority of cases consists of advertising followed up by personal solicitation.

C. C. Gartland.

The best advertisement a company can have is steady, uninterrupted supply of current, always kept at the proper voltage and constantly called to the attention of the people by solicitors who know their business.

United Elec. Lt. Co.

Good service and personal solicitation. All other forms of advertising merely supplement these.

Douglass Burnett.

Newspapers, a good follow-up, with some use of a few other mediums, should do.

Frank C. Farrar.

We consider solicitors the best advertising medium that the company can adopt.

R. N. Kimball.

V 21. Is it not a good idea for solicitors to visit their customers continually, whether they buy or not, so as to show an interest in them?

Yes, if the man has tact and judgment.

C. R. Price.

The most propitious time to show interest in any customer or prospective customer is when he is not in the market for your goods. If he is in the market and you visit him he feels that you are not so much interested in his success as you are in his pocketbook, and if you sell him and drop him he has evidence that this is the case. He has no incentive for gratifying your interest in his pocketbook, and if his necessity has obliged him to do so he has derived no pleasure from it. A pleased customer is the best advertisement any salesman can have. I have, in twenty-five years in the business, yet to meet the central-station manager who pays too much attention to cultivating contentment among his patrons, and it has been my experience that the larger the concern, the less attention is paid to this important feature of the central-station business.

Chas. B. Burleigh.

Yes, and they can not call too often. An experienced man knows, of course, when he is a bore, and must leave; but there is nothing like keeping after the prospective customer.

Wm. M. Lewis.

A man would be a poor solicitor if he did not visit his customers frequently and hear their complaints or praise of the service.

United Elec. Lt. Co.

Yes, an excellent one.

J. H. Enright.
P. H. Korst.
F. Ellwood Smith.

Yes; friendly relations with consumers are productive in discovery of grievance, as well as having the effect of obtaining greater revenue by encouraging the use of current.

C. C. Gartland.

An excellent idea, if you can spare the solicitors.

M. C. Turpin.

It is of the utmost importance that the solicitor be well acquainted with every merchant or customer in his district, visiting them continually from time to time, taking an interest in their business and attempting to show in what manner electricity would be of benefit to the prospect.

E. W. Lloyd.

Yes. I believe it is an excellent plan for the solicitor to make extended calls upon the consumer, even though that consumer may not be an immediate prospect for additional business. It should be the policy of every gas and electric company to create and maintain a friendly relationship between the company and its consumers and to make sure that the consumer is securing the best possible results from the service which the company is extending to him. This policy has been followed out by several companies and is meeting with decided success. The solicitor in making extended calls upon the consumer is able to ascertain as to whether or not the consumer is getting the best results from the service. This will tend to make a satisfied consumer who will not only be a booster but one of the best advertisements that the company could have.

R. F. Bump.

V 22. Which do you consider the more efficacious means of bringing in business to the company—personal solicitation, or advertising?

Personal solicitation.

Alex. J. Campbell.
E. R. Davenport.
Ludwig Kemper.
P. H. Korst.
F. Ellwood Smith.
Douglass Burnett.

One should supplement the other.

C. R. Price.

Personal solicitation will no doubt bring the most orders. Advertising will reduce the number of calls the solicitor has to make.

Percy Ingalls.

Both go hand in hand, and one method should be used to help the other.

C. C. Gartland.

Personal solicitation, backed up by advertising of a high grade.

United Elec. Lt. Co.

Solicitation done by competent men and backed up by object lessons.

J. H. Enright.

A judicious combination of both.

B. W. Mendenhall.

Personally, I believe in personal solicitation as the best method of obtaining new business. I also believe that the work of the solicitor should be preceded and followed up by the proper advertising matter.

E. W. Lloyd.

Personal solicitation. However, judicious advertising will prepare the field and very materially assist in bringing in business that will be proportional to the persistent efforts put forth in personal work.

W. E. Comer.

V 23. Give whatever data you have showing the advertising value of electric signs.

V 24. How can free signs be made profitable if each sign is special?

By exacting a minimum charge on the basis of a three-hour consumption per lamp per night for twenty-five days in the month. With a rate of 10 cents per kilowatt-hour the monthly minimum on a 50-16-cp sign would be, in round figures, $20 per month, which would represent the guaranteed consumption.

Frank W. Smith.

So far as we know, it has not been demonstrated that free special signs are profitable.

E. W. Lloyd.

V 25. What means have been found advantageous for displacing gas engines and in their stead installing electric motors? How would you dispose of the gas engines?

Install motors on trial and the comparison under working conditions does the rest. It will be necessary occasionally to sell the motor on the instalment plan so that the new investment will not appear so big.

R. H. Garrison.

The best argument against the gas engine is the engine itself. The life of the average gas engine is comparatively short and the cost of repairs in the majority of cases is extremely high in proportion to the cost of the engine. The unreliability of the gas engine is proverbial. Many of the engines are installed in unsanitary, dirty places, covered with grease. The odor from the exhausting gas is very objectionable. In replacing gas engines with motors it is well to point out the value of the use of several motors, making it possible to operate at least part of the factory in case of the breakdown of any one unit, whereas, with the gas engine, in the case of a breakdown the whole shop is idle. The use of several motors generally removes a part of the friction loss, thereby reducing the amount of power required to drive the machinery. Very often a trial installation of motors will convince the customer.

The rates now charged for electric power throughout the country are such that they can generally compete with gas at 50 cents. We have disposed of a great number of gas engines to dealers who have overhauled them and sold them in the country, where electric power in many cases is not available.

E. W. Lloyd.

The following facts on the two propositions constitute a good argument:

A modern 20-hp engine using city gas should develop a brake-hp on about 25 cubic feet per hour; the cost of the fuel will then be

$$\frac{25 \times 20 \times 8 \times 1.00}{1000} = \$4.00 \text{ per 8 hours.}$$

Assuming the gas-engine installation to cost $50 per brake-hp and assuming interest at 6 per cent, repairs at 3 per cent and depreciation at 10 per cent, these fixed charges will be per day

$$\frac{50 \times 20 \times 0.19}{365} = \$0.52,$$

or a total of $4.52 for 8 hours, exclusive of attendance and oil. Assuming for the motor a mechanical efficiency of 95 per cent, there will be required

$$\frac{20 \times 746}{0.95 \times 1000} = 15.7 \text{ kilowatts.}$$

The cost of current for 8 hours is then

$$15.7 \times 8 \times 0.04 = \$5.024.$$

Assuming the motor to cost $20 per horse-power, and interest, repairs and depreciation as before, the fixed charge will be

$$\frac{20 \times 20 \times 0.19}{365} = \$0.20,$$

or a total cost per 8-hour day of $5.224, exclusive of attendance and oil.

If the gas engine requires an engineer at $60 per month or $2.00 per day, and no extra attendance for the motor, as is usually the case, the respective cost of power will be $6.52 for the gas engine and $5.22 for the motor. The cost of oil and waste will be small and is not included in either of the above estimates. The cost of the last items, including cooling water, will be considerably greater for the engine than for the motor.

Might dispose of gas engine to some combination gas and electric plant.

C. C. Gartland.

The time to displace gas engines is in the summer when your load is light and you can afford to make a proposition to install a motor on 60 days' trial, with the understanding that if it is not satisfactory you will remove the motor and charge only for the cost, or a portion of the cost, of wiring and for the current consumed.

Provided you have a fair rate (one that will bring about 4 to 5 cents per kilowatt-hour on long-hour running), you need not fear gas competition. At least, we have found this to be the case.

E. C. Stahl, Jr.

V 26. What arguments are used with consumers contemplating individual plants?

If an acetylene plant is contemplated, show consumer cost per 1000 feet of gas manufactured from carbide, with attendant danger as compared with electric current. If isolated electric plant operated by gas or gasolene engine is contemplated, show amount of gasolene required to produce a kilowatt-hour, cost of repairs to engine, liability to breakdowns and poor service, as compared with first-class service from your lines at reasonable cost.

J. H. Enright.

A private plant requires a large investment, which is likely to be lost in case of loss by fire, water, and by natural depreciation. In the majority of cases it can be shown, by careful estimate of the cost of installation and operation, that the operation of a private plant is more expensive than central-station service. Explode the fallacy that the steam for lighting costs nothing, since all of the exhaust steam is available for heating, in this way: There is considerable loss from the engine, in the shape of drips and leakage of steam pipes; while this appears small, a drop of water represents considerable steam. In engines of this class there is usually a great deal of condensation in the cylinder and exhaust piping, and as a result, only about 50 per cent, and sometimes less, of the steam going to the engine is available for use in the heating system; this leaves 50 per cent of the coal used during the heating season chargeable to the lighting. The entire cost of coal during the summer months must be charged to lighting. In case a private plant is installed in the basement of a building used for offices, stores, apartments, or other purposes, the heat arising from the steam plant in the basement during the summer season will often raise the temperature of the building two or three degrees. This very thing was so marked in the case of two plants in this city, that both owners had to remove the plants from the basement and re-install them below the surface of the ground in the rear of the buildings, or lose their tenants. One was an office building and the other an apartment house. In the case of a hospital in this city we closed down the private plant on account of the incessant hum from the machinery making the patients nervous. In this case, also, the cost of operation was largely in advance over what service from our mains had cost them, and this in spite of the fact that the hospital required a large amount of steam for heating and cooking purposes the year around. The success or failure of a private plant is often a personal matter. If the owner is fortunate enough to secure an engineer who takes a great pride in the plant, keeps all leakage stopped, saves all drips, is economical with the oil and waste, watches the steam pressure closely and fires carefully, the plant may pay. Such men, however, are rare, and their services can not be secured for a small private plant except at a prohibitive price. A few references to isolated plants that have failed on account of inefficient engineers will start the prospect to thinking seriously on this proposition. Most of them will realize that the private plant is a gamble at the best, and few will be willing to gamble where $5,000 to $25,000 is at stake. The smoke and dirt incident to a private plant will often depreciate the value of property for both sale and rental purposes more than the total cost of lighting and power from the company's mains. The constantly increasing use of basements for restaurants, cafés, barber shops, rathskellers, Turkish baths and manicuring establishments, renders this space too valuable to utilize for a private plant. After the above arguments have been worked for all they are worth, and made to apply locally as far as possible, a good, fair proposition to supply the prospect with light and power for public purposes, such as halls, toilets, elevator lights, and so forth (and this is long-burning business and consequently can be sold for profit at a low rate), with the privilege of metering power to the prospect's tenants at tariff rates, will usually secure the business.

B. W. Mendenhall.

First, it is much cheaper for them to install central-station service than to put in their own plant. We give them much more reliable service, and continuous service for twenty-four hours a day. Using our current, they know exactly how much per kilowatt-hour it will cost for the term of contract, with the certainty that it will be the same or lower at next signing, as electricity is surely becoming cheaper, but coal is becoming dearer. Besides, so much depends on the engine, engineer and fireman they have. It can be figured to a certainty just what the labor and heating of their building will cost, also the light and power, if they have our current. Show them what a building of the character they are figuring putting the plant in will cost for power, light, labor, and then the heat—which is the most important subject. Take buildings we now light and supply with power, and show the figures on cost of heating same for the past three years, at so much per 1000 cubic feet of contents per month. In winter no saving will be made, but there will be a saving in summer months. Read them letters you have received from people who changed from their own to central-station current and thereby saved money and had better satisfaction. These arguments I consider the most important.

W. A. Cowling.

We have displaced several gas and gasolene engines because the customers find the convenience worth the difference in price.

R. N. Kimball.

W—CONTRACTS AND RATES

W 1. In general, is the ratio of charges made for electrical energy to the large customer to that made to the small customer in proportion to the ratio of the costs of their respective service?

W 2. In the demand system of charging, should the minimum charge be placed at a nominal sum for all customers—that

is, $1.00 per month—or should it be made proportional to the customer's maximum demand? (a) For lighting. (b) For power. What minimum charge do you require from power customers from 1 to 25 horse-power?

Minimum charges for power: $3.50 for a 3-hp motor; $5.50 for a 5-hp motor, and $10.50 for a 10-hp motor, and so on.

C. R. Price.

It should be proportional, but we do not as yet make it so for lighting. For power, our minimum bill is at the rate of $1.25 per month per horse-power of motors *installed,* except in large installations with numerous motors, when the maximum demand is determined from time to time by test, and on it the minimum bill of $1.25 per horse-power per month is based.

S. P. L. & H. Co.

I believe there should be a minimum charge of $1.00 per month on residential customers. On all other customers for lighting or power there should be a minimum charge of not less than $1.00 per horse-power of maximum demand; this maximum demand to be taken each month.

F. C. Sargent.

(a) One minimum covers all. (b) Minimum is by the horse-power.

The Pueblo and Suburban Traction and Lighting Co.

(a) We have entirely removed the minimum from our lighting contracts, and we think we have derived a great benefit from so doing.

E. W. Lloyd.

(a and b) Proportional to maximum demand.

B. J. Denman.

W 8. In cases where a maximum-demand meter is installed, do you figure each month's bill on the demand shown for that month or on the maximum demand for the year?

Some companies do one thing, some the other, and some do both. It is really a question whether power should be rented by the month or by the year, and there seems to be no reason why both should not be done. If a customer rents power by the year he should get a low rate per horse-power, and should be charged on the basis of his maximum demand during the year. If, however, he does not use frequently the power represented by his maximum demand, it would be better for him to rent his power by the month even at a higher rate per horse-power, and in such case he should be charged on the basis of his maximum demand for the month only. In other words, most customers should be charged on the monthly reading of the indicator, but contracts for a year or more should be offered with demand charge based on annual reading, and at a lower rate per horse-power.

J. S. Codman.

This is answered in W 2.

F. C. Sargent.

On demand meters we generally figure the discount monthly if the nature of the work is the same, but if there is likely to be great differences in consumption during different months in the year, then the heaviest months are figured together and average taken, and the same with the lighter months.

Wm. M. Lewis.

In cases where we have a maximum-demand contract we figure each month's bill on the demand shown for that month.

E. W. Lloyd.

Demand meters reset only once a year.

B. J. Denman.

W 4. With a demand system of charging, how do you assess the maximum demand of residences and customers for whom you do not install a demand meter?

Wm. M. Lewis.

Residences: four-tenths of lamps installed, measuring in 16 candle-power. One kilowatt-hour per lamp per month for each of above lamps at 20 cents per kilowatt-hour, all other current at 7 cents per kilowatt-hour.

C. R. Price.

Based on number of living-rooms and bedrooms. This does not penalize customers for providing lights for convenience, as does a system basing demand on number of lamps installed.

B. J. Denman.

We install maximum-demand meters for all residence customers where they have seven or more lights. For residence customers where they have less than seven lights, no maximum-demand meters are installed. We take the connected load as the minimum.

E. W. Lloyd.

W 5. What is the best method of adjusting the minimum charge, and how is the subject of minimum charge best presented to a customer without actually calling it a minimum charge?

It is difficult to see how any reasonable person can object to a minimum charge. However, by way of explanation it is well to let your customer know that your equipment must be operated continuously, so as to meet his requirements at any time during the day or night, all of which costs you money in the way of coal, labor, and depreciation of your machinery. Your customer may have a telephone that costs him from $18 to $25 per year whether he uses it or not, which you might call readiness-to-serve charge, as some like this term best.

J. H. Enright.

Why not say frankly that it is a minimum charge and that if the service is not worth so much to the customer the company does not desire the business, because for less than the minimum charge, and probably even for the full minimum charge, the company would be rendering the service at a loss.

Alex. J. Campbell.

We do not try to conceal the fact that it is a minimum charge.

The Pueblo and Suburban Traction and Lighting Co.

The minimum charge should be made the smallest amount for which the company can afford to furnish the service required by the consumer. The object of a minimum charge can be explained to a customer as being the smallest amount for which the company is justified in making the expenditure necessary to connect the service, furnish the meter, and send out and collect monthly bills; also to stand in readiness to serve to the consumer sufficient current for his entire installation at any minute during the month. Any reasonable customer can understand that there is an expense attached to these items which must necessitate a fixed income, otherwise the company will be better off without his business.

Fred Leslie.

We do not consider it difficult to induce customers to sign contracts having a reasonable minimum. We do not see why it should be called by any other name than minimum charge.

E. W. Lloyd.

There is no objection to calling a minimum charge by that name. A minimum charge should be fixed on the basis of the cost of maintaining the investment in and the proper operation of the meter and the maintenance of the separate consumer's account for the meter. A minimum charge is entirely proper for auxiliary service of all kinds, including breakdown connections or reserve connections for isolated plants, motor-service auxiliary and reserve to engine service; also for classes of service supplementary to the regular class of service, such as direct current in alternating-current districts.

Minimum charges may also be properly charged in connection with alternating current involving fixed transformer losses in connection with any customer, and may properly be applied in connection with excess meters installed over one or two per customer. As a general proposition, minimum charges are not advisable in connection with underground direct-current service in the business district of the city, but if it is not the custom to make a minimum charge, careful selection of prospective business should be made, in order to secure only a desirable class of customers.

A minimum charge is entirely proper for the protection of the company in those cases in which an extension has to be made to reach the individual customer, thus representing a certain investment on the company's part; also in those cases where a lower rate is made in consideration of a guaranteed monthly revenue or a fixed minimum charge.

Douglass Burnett.

W 6. In cases where prepayment meters are installed do you require consumer to sign contracts or is any minimum exacted? How is matter handled?

Prepayment meters are installed without obtaining application, or without any record as to name of occupant. No minimum is charged.

Frank W. Smith.

We do not have contracts; in fact, we do not care much whether we have the correct name or not.

The Pueblo and Suburban Traction and Lighting Co.

At the time we installed prepayment meters we asked the customers to sign an application that allowed the customer to discontinue using our service at any time and also allowed the company to remove its meters and lamps and to cancel the application at any time the customer failed to deposit in the meter a sufficient amount to warrant the maintenance of the service.

Since discontinuing the minimum monthly bill on our lighting contracts, we have had no demand for prepayment meters, and are gradually getting back all the meters that were in use.

E. W. Lloyd.

W 7. Has any company tried the Doherty rate of charging for current and given it up as being unsuitable? If so, why?

Evidently not. No answer received.

Editor.

W 8. What effect has the demand system of charging had on your load curve? Has it improved your load-factor or net earnings sufficiently to justify a reduction in the base rate?

W 9. Our company is operating a 24-hour, all-meter circuit. How best can we give our customers a low rate for current used off the peak and still maintain our maximum rate during the peak load without incurring too much expense for changes?

We think we accomplish this fairly well by charging the full rate for an amount equal to burning the number of lamps at which customer is rated 50 hours per month, and one-half rate for all in excess of this amount; that is, a customer with eight lamps would be charged the top rate for 22.4 kilowatt-hours each month, and one-half rate for all in excess of 22.4 kilowatt-hours. In residences we take about 40 per cent of the number of lights installed as the rating, so that a residence with 20 lamps would be rated as an 8-light installation.

Bennington Electric Co.

Adopt a differential rate, as practically all customers want service during the peak load.

B. J. Denman.

A good plan to take care of the conditions mentioned in your question is with a two-rate contract; this contract is made up by charging the maximum rate on the entire installation for the number of peak-load hours you have during the month. The current used in excess of this amount can be furnished at a low rate on account of being used off of the peak. For example—if your consumer has an installation of one kilowatt and your peak load runs 60 hours per month and the consumer's meter registers 100 kilowatt-hours, you would charge the maximum rate for the 60 kilowatt-hours and for the remaining 40 kilowatt-hours the rate used for off-peak business. Think it is well with a contract of this kind to make the minimum cover the entire peak-load hours.

Fred Leslie.

W 10. Where flat-rate consumers use their lights longer than their contracts allow and notices to such effect have been sent out without avail, what can be done where gas competition is strong?

Put them on meters with GEM lamps.

J. A. Lane.

Install meter during shortest lighting period.

The Union Elec. Co.

Install meters.

Frank W. Smith.

Discontinue flat rate.

B. J. Denman.

Where you have flat-rate customers you should do the switching yourself, and in that way prevent the possibility of burning the lights for longer periods than the contracts are made for. Some of our flat-rate customers have an overtime meter whereby they can use the lamps outside contract hours and pay the regular commercial rates.

E. W. Lloyd.

Where flat-rate customers can not be properly regulated it is best to discontinue serving them—competition or no competition. You do not want any business that does not yield a profit.

B. W. Mendenhall.

W 11. What is best way to change over from a flat-rate to meter-rate basis? Residences mostly on meters, business mostly on flat rate.

Better not to change completely to a meter rate, as a meter rate alone has an undesirable effect on the business, favoring the short-hour consumer at the expense of the long-hour consumer. It would be better to maintain the flat rate, but to reduce it, and then to charge in addition a low rate per kilowatt-hour by meter. The meter charge would stop the waste usually attendant on a flat-rate system of charging, and the combined meter and flat rate would result in low average rate per kilowatt-hour to the long-hour users, which is just what is wanted.

J. S. Codman.

Make change in long-days burning, and if necessary agree to put on meter for a month and allow customer to try same and if not satisfactory to pay old contract rate for one month.

J. A. Lane.

Simply do it. It is best, however, to do it during April, May and June. Give a few rebates, if necessary, until people become accustomed to the use of light on a meter. For a complete answer to this question see W 2, vol. ii, 1905 Proceedings.

Alex. J. Campbell.

Advise customers that everybody is going to be changed over to meter rates where every one pays the same, and that there is no favoritism. The business man can be told that he does not sell his products by contract, and why should we? He'll agree in a minute. Always change over the contracts in the light-consumption months and read the meters, say, every week, show the consumer just what he has used each week and compare this week with last week and he'll come around very nicely.

Wm. M. Lewis.

Install meter during short lighting period.

The Union Elec. Co.

Do so gradually.

The Pueblo and Suburban Traction and Lighting Co.

In order to demonstrate to a flat-rate customer that a meter rate is not excessive, it is necessary to install a wattmeter for a few months. Show the customer the wattmeter readings, and if the rate is right you should have no difficulty in changing him over to the meter basis. Of course if the flat rate is very low and you wish to raise the rate, you will have some difficulty in finding an argument that will persuade a business man to change.

E. W. Lloyd.

Install a meter on each service, so as to ascertain just how much electricity is used. You will find some customers who will gladly change and pay less money. Get them to tell others they have changed. Change rate in June or July when meter bills will be lowest.

F. Ellwood Smith.

W 12. What is a satisfactory rate for lighting current in a village with 800 lights where it costs 10.9 cents per kilowatt to manufacture the current? Our schedule is very unsatisfactory.

Almost any profitable rate made would be prohibitive.

The Pueblo and Suburban Traction and Lighting Co.

W 13. How do European rates for incandescent lighting compare with rates in United States?

W 14. What are highest and lowest rates for street lighting in cities of the first class?

We think from $56 to $150.

J. A. Lane.

W 15. A factory customer buying power from a central station installs a motor-generator for lighting, thereby getting lights at the power rate but incurring the loss in motor and generator. The station carries this loss at the peak. Is it advisable to make a special lighting rate to avoid this, or what should be done to overcome the difficulty?

It would certainly appear sensible to make a special lighting rate to cover this particular case. Assuming 85 per cent efficiency in both motor and generator, the combined efficiency would be less than 75 per cent. The customer could therefore afford to pay a rate one-third higher than the power rate, and save the wear and tear of his motor-generator. The company would receive same income and have 25 per cent less current on its peak, from this particular source.

C. R. Meston.

Customer should be prohibited from doing this or given a contract in which the rate is determined by the load-factor.

B. J. Denman.

We do not allow customers to install motor-generator sets running from the power mains to be used for lighting purposes. Even if the customer's lighting business is exceedingly large, it would be bad policy to allow him to use a motor-generator set. A rate for light in keeping with the size of the customer and the load-factor should be allowed. The general condition should settle the rate and obviate the necessity of installing such a piece of apparatus.

E. W. Lloyd.

Cover this in your rates by stating definitely that power rates do not include the running of dynamos for electric-lighting purposes.

F. Ellwood Smith.

Probably the simplest way to solve this would be to charge a higher rate for power used on the peak, regardless of what it is used for. This can be done by almost any of the demand systems of charging, combined with a recording instrument.

B. W. Mendenhall.

W 16. A small station of 670-kw capacity has 180 kilowatts on the water-wheel and the remainder on steam. Average peak load is 350 kilowatts. Water is obtained from a canal that has much anchor ice. A mill on the same canal, using water-power only, wishes 125 horse-power for auxiliary service when handicapped by anchor ice. When anchor ice sets in, the station wheel goes out of business before the mill wheel. What is a fair minimum annual bill and what would be a fair daily charge for ten hours; coal $4.50 a ton, lighting rates $0.14, power rates down to $0.0325?

If mill desires you to carry the investment necessary to provide this auxiliary service it should pay all fixed charges and a reasonable profit on the investment required, this to be an annual charge whether power is furnished or not. Then sell current at cost of generating.

B. J. Denman.

W 17. What would be a fair price per year for lamps under the following conditions: Two hundred 16-cp lamps on moonlight-midnight schedule, coal $4.50 per ton. Lamps in multiple through transformers supplying 12 lamps each?

W 18. Should an opera house having a large connected load that is used only a half dozen times a month receive any advantage in rates?

No.

J. A. Lane.
The Pueblo and Suburban Traction and Lighting Co.

Can see no reason why opera house should receive any better rates than other customers using the same amount of current per month.

H. Clyde Parrish.

For opera houses, skating rinks, and similar installations that are largely off-peak business, we make a fixed charge of about 25 per cent per annum on the cost of transformer capacity required and meter the consumption at one-half regular commercial rate.

S. P. L. & H. Co.

Opera-house lighting in a small town is not especially good business, though in our case the load really comes off the peak, as most of the entertainments are during the winter and we drop a large portion of our load from six to half after six o'clock. We do not give them a special rate.

Bennington Electric Co.

I do not believe a load of this kind should receive any advantage in rates.

F. C. Sargent.

On the contrary, they should be required to pay a minimum bill based on their demand.

B. J. Denman.

Opera-house load is practically off-peak business, and we believe it is a class of business entitled to a special rate on this account.

Fred Leslie.

We should say that an opera house using current half a dozen times a month would be a very poor load for a central station, and that it should not receive any advantage in rates.

E. W. Lloyd.

We do not think so. They can not afford to operate a private plant under these circumstances, provided they have a reasonable rate from the central-station company.

B. W. Mendenhall.

W 19. What standard form of contract do you use? (a) For lighting. (b) For power.

W 20. If a power schedule is based on a stand-by or demand charge what is the most accurate commercial method of ascertaining the demand on polyphase installations?

Wright demand meter on each phase.

F. C. Sargent.

By counting revolutions of disc of recording meter. Take average of ten one-minute tests. Make tests periodically.

B. J. Denman.

W 21. In consideration of the low power-factor of Moore tubes and consequent larger investment required per kilowatt connected, should a higher price per kilowatt-hour be charged for current supplied to these tubes?

The answer is, no; but the whole question is based on a fallacious assumption. The power-factor of the Moore tubes is not low. Some early tubes had low power-factors, but several months ago an order was issued that no tube be allowed to run under 60 per cent and to keep the average above 65 per cent, and some of the Moore tubes now in use have power-factors as high as 80 per cent. The tests of the tube at Bamberger's store, published in the *Illuminating Engineer*, showed it to have a 56-per cent power-factor, but the next day, almost a year ago, by simply adjusting the automatic feed, the power-factor was raised to 65 per cent, where it has since been operating. The *Central Station List and Buyers' Manual*, in its reference tables, shows that many of the constant-potential enclosed-arc lamps are operating at a 48-per cent power-factor and none of them have ever claimed, even for temporary use, a power-factor higher than 65 per cent. There is no theoretical reason why all Moore tubes should not shortly operate at about 90 per cent, but even now their average power-factor is very much better than that of alternating-current motors and the average arc lamp. This question should have been reversed, because there are many very salient reasons why a lower price per kilowatt-hour should be charged for current supplied to Moore tubes, as follows:

First, no maintenance charge. On this basis alone the charge should be 20 per cent less than for incandescents, Nernsts or arc lamps or the expensive flaming arcs.

Second, the Moore tubes are now and will continue to be more and more day loads, thereby reducing the peak on the central station. Many areas are now being lighted in daytime that were impractical to illuminate electrically when the cost was six times greater, as with incandescent lamps.

Third, in spite of its enormous efficiency it many times increases the revenue to the central stations.

Fourth, the Moore tubes occupy a new field and thereby really form a new business department for every central station. It is especially advantageous for the alternating-current central station to push the Moore tube when competing with direct current, since it can produce six times as much light for the same amount of money as can be produced on direct current.

Fifth, in order to carry out the doctrine of "all together all the time for everything electrical" the electric light companies should see it is to their interest to push a good thing—a system that is incomparably better than any of its competitors as regards either diffusion, color or safety.

D. McFarlan Moore.

W 22. What is the common conception of the term "horse-power-year"? What number of hours per day and what number of days per year are contemplated in this term as applied to sale of power at stated price per horse-power-year?

Ten hours per day for 300 days.

J. A. Lane.
S. P. L. & H. Co.
F. C. Sargent.

It is the operating hours of the plant for a year. For instance, if it is operated 10 hours a day for 6 days a week we figure the horse-power at 10 hours for 312 days a year. If a company were buying power, it would be figured at 24 hours a day for 365 days a year.

L. G. Coleman.

The writer's conception of the term "horse-power-year" is based on 24 hours per day and 365 days' per year use of one horse-power, or 8760 horse-power hours.

E. W. Lloyd.

The conception of the term "horse-power-year" varies greatly among laymen. The smelters and larger industries in the West use the average horse-power-year as their unit; that is, the total horse-power-hours generated per year divided by 8760. This is figured month by month and aggregated for the year. For plants that do not operate 24 hours per day, the number of horse-power-hours developed per month or year divided by the number of hours operated in the same period is taken as the unit. From the standpoint of the central station, we think both of these methods are incorrect. With nothing to the contrary specified, the sale of power at a given price per horse-power-year would permit the continuous use of each horse-power 8760 hours per year. If, however, the customer does not utilize this power, it is his loss and he must pay the company for holding this power available for his use. That is, the bill should be rendered on the basis of the price per horse-power-year times the maximum demand in horse-power.

B. W. Mendenhall.

The load-factor is always stated when selling power on this basis. This is as necessary in hydraulic as in steam plants. In hydraulic plants the lower the load-factor, the less the price per horse-power-year, as it is possible to oversell the capacity of the plant to a greater extent. This also depends on the capacity required; the greater the capacity, the less the plant capacity could be oversold. With one large customer taking the entire capacity it could not be oversold at all, but the greater the number of customers, the less the probability of all maxima occurring at once. In steam plants the coal cost depends entirely on the load-factor.

B. J. Denman.

W 23. Has any member been successful in getting large grain elevators to equip for electricity and use central-station service, and how did he go about it?

W 24. Please state briefly any scheme for getting old, unwired residences wired and getting their occupants as consumers of electricity.

Take payments in instalments.

C. R. Price.

We found free wiring taken up periodically by districts very successful.

The Pueblo and Suburban Traction and Lighting Co.

The best scheme, I believe, would be a vigorous campaign carried on through the advertising department and one or more good solicitors to call on parties owning the property.

J. T. Connors.

Offer to do the wiring for them through a contractor, if desired, and let them pay for same in monthly instalments extending over a period of from three to six months. If the prospective customer is a tenant it might be wise in some cases to divide equally with the owner and tenant the expense of wiring the house. A long-term contract should be secured in this case.

M. C. Turpin.

W 25. Has any effort been made to induce National advertisers to use electricity for advertising purposes? Why not make a uniform fixed rate for this class of advertising, which would apply to cities and towns of like class, so that these advertisers could include electric advertising in their appropriation, the same as newspaper, bill-posting and painted-sign work?

Mail solicitation has been employed with some success. Local sign company that handles the business is now favoring the use of lighting to some extent. A uniform rate has been talked about and considered. In our opinion some such arrangement will be evolved some day, but the plan has not yet been suggested.

Frank C. Farrar.

W 26. Has a satisfactory time switch, which will turn current on and off, been put on the market?

We have obtained excellent satisfaction from a time switch made by the Albert and J. M. Anderson Manufacturing Company, of Boston, Mass.

Alex. J. Campbell.

We find that the Ballou-Hutchins switch and that of the American Electric Sign Company are both very satisfactory switches.

F. C. Sargent.

W 27. Is it advisable to set a wattmeter as a check on a flat-rate sign equipment?

We occasionally check our flat-rate customers by meter, mostly to find out if it will be profitable to renew their contracts on expiration.

Ludwig Kemper.

It is advisable to set a wattmeter on a flat-rate consumer to see what he actually burns. You must know how much he consumes, as he will, of course, use more than is agreed upon, and when it gets to such a point that he is getting his current for about half what the others pay, it is bad business and should be discontinued. This is what it eventually comes to. Besides, a meter should be installed for the reason that you should know what your total output is, according to consumers' meters, and figuring line losses any other way is considerably out of the way. Meter everything.

Wm. M. Lewis.

Yes.

The Pueblo and Suburban Traction and Lighting Co.

As a general proposition, we do not consider it necessary to install wattmeters on flat-rate sign installations. It is an unnecessary investment.

E. W. Lloyd.

It is not necessary to set a meter on a flat-rate sign equipment to determine the current consumption in those cases in which the turning on and off of the sign is within the control of the company, or the hours of turning on and off are subject to such check or control that the company is assured of waste being prevented, which can be accomplished by the close supervision of the lineman attending to the signs, or of the time switches used in connection with them. If the control of the sign—that is, the turning on and off—is left entirely with the customer and is fixed by agreement, it is desirable to have a meter installed as a check against waste. In any case, the income statement should account strictly for all the current used and sold. It is advisable to set check or test meters in a few cases to confirm the estimated amount of current consumption.

Douglass Burnett.

I would put a recording wattmeter on every service—otherwise you can not check up the electricity sold.

F. Ellwood Smith.

It is very essential to have a wattmeter on every flat rate. There is a tendency and a possible chance for the consumer to allow a flat-rate sign to burn all night, or for him to install larger candle-power lamps, or to connect interior lighting; therefore the wattmeter is excellent as a check and is the best way for the company to account for its lost and otherwise unaccounted-for current.

L. K. Reynolds.

It would not seem particularly desirable, inasmuch as you know the time of hours burning exactly and it is a simple matter to figure the number of watts used. It would mean an investment in the meter that would hardly seem to have a fair return.

M. C. Turpin.

W 28. How does the sign operated through a time switch and charged for at a flat rate appeal to your customers?

We find that this plan appeals to our customers better than any other we have tried. We apply it to both signs and store-window lighting.

Alex. J. Campbell.

Very successfully.

The Pueblo and Suburban Traction and Lighting Co.

We have a number of flat-rate signs operated by time switches. The customers seem to have no objection to this method of controlling the sign.

E. W. Lloyd.

This appeals to the customer all right, but where a patrol system is used for turning signs on and off, this would be unnecessary.

M. C. Turpin.

X—ACCOUNTING AND STATISTICS

X 1. If the Standard System of Accounts for Electric Lighting Companies adopted by the National Electric Light Association is correct, why is it not adopted by the Commission of Gas and Electricity of the State of New York, so that the accounts of the electric light companies and reports to the state may be uniform?

X 2. What is being done toward obtaining a uniform and accurate system of classification of accounts?

X 3. What is considered the maximum percentage of operating expenses to income at which a medium-sized electric light plant can show a fair return on the investment?

Fifty per cent.

J. A. Lane.

X 4. What is a good method of recording the cost of individual extensions to distributing system and revenue from the same and of determining whether the investment was justified?

X 5. What is the best general method for prompt collection of municipal accounts?

X 6. What are your total canvassing and advertising expenses per year per incandescent-lamp equivalent added to your supply system?

X 7. Do you think a 7-per cent depreciation charge is too high?

I consider 6-per cent depreciation high enough for electrical apparatus, 4-per cent for buildings, and 3-per cent for conduit and cable.

E. J. Fowler.

It is assumed that this question refers to central-station equipment, exclusive of land and building. If so, the 7-per cent depreciation charge is not too high, especially when such equipment is used to supply service to a progressive and growing community. Under these conditions a proper depreciation charge would even be in excess of 7 per cent and would be due more to obsolescence than to natural wear and tear.

C. A. Keller.

X 8. What is the ratio between maximum indications taken from demand indicators on consumers' premises and maximum station load on any station having complete equipment of demand indicators?

The ratio referred to is commonly known as the "diversity factor," and in using same it should be stated whether the station maximum demand is taken at the switchboard or at pressure of supply to customers. If the latter definition is used the distribution loss does not enter into the question of the diversity among customers in the time of taking their maxima. With last definition, diversity factor for a station is likely to lie between 1.25 and 2. Diversity factor of residence customers only will lie between 2 and 3, and for power may vary greatly and may run up to 4 and 5.

J. S. Codman.

X 9. What is the average line loss between switchboard and consumers' meters?

X 10. What percentage of difference between current registration on meters at station and those on customer's premises is consistent with good practice?

If meters on customers' premises register 75 per cent of current registered at station it is considered good practice, with the ordinary distributing system.

H. C. Stoddard.

Covering a period of a year, our total loss has averaged 19.9 per cent. This includes incandescent lighting and power, but is exclusive of street lights and railway customer, both of which are, of course, measured on the switchboard. System—3-phase, 60 cycles, 2200 volts.

Alex. J. Campbell.

X 11. Under average conditions, what percentage of power developed at waterfall or boiler-room is actually delivered to consumer?

X 12. The term "load-factor" being defined as "the ratio of the mean power used during a limited time (generally one day) divided by the total power that the station could have generated during that time" (see Hering, Ready Reference Tables, vol. I, p. 80) —is it customary to include or exclude the capacity of spare units, i. e., units not operating at any time during the period for which the calculation is made?

The load-factor of a station may be figured in three, and possibly four, different ways, depending upon what the figures are to be used for: By taking the ratio of the average to (1) the absolute maximum kilowatt, (2) the average daily maximum kilowatt, (3) the kilowatt-capacity of the plant, including spare units, and (4) the kilowatt-capacity of units operated during the period considered. The load-factor probably most commonly used is the ratio of the average load to the highest maximum during a period of one year, but it would be better to state the components of the ratio and the period covered whenever the term "load-factor" is used.

E. J. Fowler.

It is customary to include spare units, since they could have been operated had there been a demand.

B. E. Morrow.

The term "load-factor" refers to the ratio of the average load to the actual maximum load, and the term "station-factor" to the ratio of the average load to the station capacity.

B. J. Denman.

X 13. What is the best way of calculating load-factor of station?

See answer to X 12.

E. J. Fowler.

There are two ways of calculating the load-factor of a station: First, divide the average kilowatt-load for the day by the maximum kilowatt-load for the day. Second, divide the average load by the total capacity of the station. The one that gives the desired information is the best.

B. E. Morrow.

Obtain average load from recording wattmeter reading and divide it by maximum load.

B. J. Denman.

X 14. Can the power-factor be calculated from ordinary station readings on voltmeter, ammeter and wattmeter? Please give formula.

Yes.

J. A. Lane.

For single-phase circuits power-factor $= \frac{W}{EI}$. For two-phase circuits, calculate each as an independent single-phase circuit. For 3-phase circuits power-factor $= 1.73 \frac{W}{EI}$. Where W = watts in circuit, E = volts between wires, I = current in wire. In case of 3-phase circuits W is the total watts and I must be the current in each wire. If these are not equal the above formula can not be used.

H. L. W., C. E. I. Co.

Yes. See X 13.

B. E. Morrow.

Power-factor $= \frac{W}{EI}$ in single-phase circuit.

In a 3-phase circuit (if it is balanced) power-factor $= \frac{\frac{2}{3} W}{\sqrt{3}\, EI}$.

E = reading of switchboard voltmeter across two mains.
I = reading of switchboard ammeter on one main.
W = reading of switchboard wattmeter across same mains.

NOTE.—In the case of 3-phase conditions there are *two* wattmeters on the switchboard, the sum of whose readings is equal to the total power on the *three* phases. Hence the power taken by one phase is two-thirds of this if the system is balanced.

John Cyrus Distler.

Yes. Voltmeter reading times ammeter reading equals apparent watts. Indicating wattmeter reading equals true watts. Power-factor equals the true watts divided by the apparent watts.

W. O. Haymond.

X 15. Give a sample of daily station report and load diagram for a combined railway and light station?

X 16. Considering only operating expenses, is a single-phase equipment for general power service more economical than a 3-phase system?

Single phase for small towns.

J. A. Lane.

X 17. How many kilowatt-hours, per capita of territory, did you generate during 1906?

Generated 150 kilowatt-hours *per capita.*

Ludwig Kemper.

Forty kilowatt-hours.

F. C. Sargent.

Kilowatt-hours generated *per capita* 1906, 440.

B. W. Mendenhall.

X 18. How many kilowatt-hours are consumed per lamp per annum—(a) in residences? (b) in commercial district?

Flats average 13 kilowatt-hours and houses about 10 kilowatt-hours per lamp per annum per customer. The commercial district varies with the different kinds of business.

E. J. Fowler.

X 19. (a) In a city of 250,000 people, how much per capita should be earned from lighting and small power consumers? (b) How many 16-cp lamps connected per capita?

X 20. What is a fair percentage of business connected to business removed from your circuits? In other words, for every 100 16-cp equivalents connected to the system, how many 16-cp equivalents are lost?

For every 100 16-cp equivalents put on our system, 39 16-cp equivalents are cut off. The reason for this large percentage of cutoffs is that 75 per cent of these cutoffs is on account of seasonable business, change of location and discontinuing business; 25 per cent is lost through competition, dissatisfaction and non-payment of bills.

E. W. Lloyd.

X 21. What percentage of yearly increase may fairly be expected in the total horse-power of motors in connected installations? How much horse-power have you now connected?

Our increase for 1905 was 85 per cent.

Douglass Burnett.

X 22. (a) How many companies in this country exceeded 125,000 16-cp equivalents increase in connected installation in 1906? (b) What was your increase last year, and what the population of the territory served?

(b) Light	273,120	16-cp equivalents
Power	241,820	" " "
Railway	294,550	" " "
	809,490	16-cp equivalents

Population served, 2,300,500.

E. J. Fowler.

Y—MANAGEMENT

Y 1. Will it pay to put in a special meter for ceiling fans for a few months? Is it not impractical to operate such motors and lights on the same meter and give a fair rate? Lights are on only a few hours in summer, while ceiling fans may be 24-hour service in some cases.

It is thoroughly practical to operate ceiling fans and lights on the same meter, and a sliding scale of rates would, no doubt, solve the problem in the way of a fair rate for long-hour users.

J. H. Enright.

Yes; install a meter.

Frank W. Smith.

With our two-rate system of charging, we figure the customer gets his fan on the half-rate, and an extra meter would be unnecessary.

Bennington Electric Co.

We operate both on same meter.

The Pueblo and Suburban Traction and Lighting Co.

I think it does not pay to put on a special meter for ceiling fans during the summer. The customer is afraid the bill will run too high and will not use the fan. It might be practical to operate these fans and lighting on the same meter if the amount of lighting could be estimated from the customer's bills of the same month a year ago, making a special rate on the extra current used by the fans.

Fred Leslie.

We should not consider that it would pay to put in special meters for ceiling fans for a few months unless the installation were a very large one. We have allowed customers to connect such fans to the power meter if they had one, or, as I say above, if the installation be large enough we will sign up this business at the power rates.

E. W. Lloyd.

It is advisable to make special fan contracts for introductory or advertising purposes—that is, to use fan service as a leader. The fan contracts should be made for a period of three months, subject to continuation thereafter until written notice shall be given by either party, and the customer should pay the cost of connection, also monthly minimum charge. The contract should stipulate that in the event of its being replaced during its term by a regular yearly contract for lighting or power service of the same class current, then the minimum charge would be modified to the regular minimum charge, if any, and the amount paid for connection be credited to the customer. The rate should be the basic lighting rate. If you have a two-rate or long-hour form of contract, the addition of the fans on a customer's regular lighting meter, or the extension of a fan contract into a regular lighting or power agreement, will secure to the customer a just and equitable rate, dependent upon the conditions of use of the current.

Douglass Burnett.

Y 2. Should ceiling fans be operated on meter or flat rate? Should a special rate be made for ceiling fans on account of long-hour service?

We have them both ways. We charge $5.00 per month, net, for a ceiling fan, otherwise give power rates on meter.

Ludwig Kemper.

Ceiling fans should be handled the same as blower fans. Put them on a contract basis, as it is easily figured how much current they will consume when you know absolutely how many hours each day they are operated. A meter should be placed to record the current they consume as a check. If they are operated during the day when the peak is not on, they should be given a special rate for daytime only, and these hours should be figured this way.

Wm. M. Lewis.

We believe ceiling fans will produce more revenue on a flat-rate basis than on a meter system; there are rare cases where a customer is compelled to use the fan where the income on the meter will be greater. There are more cases, however, where customers who have ceiling fans would fail to use them to any extent on account of being afraid of meter measurement. A special flat rate should be made on account of long hours, and also on account of the fact that the fan business is summer business and, as a rule, requires some special inducement to bring about the general use of fans.

Fred Leslie.

Ceiling fans should be operated on a meter rate, and preferably on the same contract, meter and service as the lighting. A special rate on account of long-hour service should not be made for ceiling fans, but the long-hour condition should be taken care of by such two-rate or long-hour form of contract as you may apply in your regular business. It should be noted that the lights will probably operate at long hours in the winter and the fans in summer, so that the tendency of this policy will be to secure a uniform current consumption from any individual customer throughout the year, if not to actually increase the summer load, which is a condition very much to be desired. Fans are generally used for day and evening service, while lights are often limited to evening use. This is the justification for the policy outlined. Further, the fans will go on the same transformer if alternating current is used for lighting purposes, and there will be a saving in that respect.

Douglass Burnett.

Should have a meter on everything. Fans should be on meter rates. If fans are operated for long hours and throughout the year they should, of course, be entitled to a low rate; but if used only in the summer, even though operated long hours, they would not be entitled to as low a rate.

F. Ellwood Smith.

(a) A meter is the only protection the company has on the premises of the consumer. It is only fair and reasonable that the consumer should pay for what he uses. Meters are used for two purposes; one to overcome the long prejudice against meters, and the other to measure the current. The only exception would be for 24-hour service; then they could be given a flat rate.

Harold J. Buell.

Y 3. How many fans should be contracted for before starting a circuit, and if on a meter basis, what percentage of increased revenue from lights already installed can be figured on?

There is no hard-and-fast rule that can be applied in cases of this kind. However, as a general proposition, the party who desires to be guaranteed a paying load before putting on a day circuit will never start one. Have started in two different towns with as few as 40 fans. In starting a day circuit I believe it best to sell appliances at cost, install a limited number free of charge, and make a strong effort to secure power business from the start. The increase from lighting will not cut much of a figure during the summer; in the winter it will be from six to eight per cent.

J. H. Enright.

Y 4. How far south must a station be located to warrant operating a day circuit for fan service?

Y 5. As the current consumption of a good desk fan is so low, is it advisable to advocate high efficiency for such apparatus?

Sell fans of the highest possible efficiency consistent with good mechanical design.

E. C. Stahl, Jr.

Y 6. Is it good practice for a lighting company to sell motors?

We get better results by selling motors ourselves, as in this way we can see to it that our customer gets a good motor.

Ludwig Kemper.

We think so—to insure a good article and to see that it is kept in good running order by occasional or periodical supervision.

C. R. Price.

I feel that it is good practice under proper conditions for the company supplying current to sell motors, for under these conditions their employees will tend to familiarize themselves with the motor characteristics, capabilities and adaptations; otherwise they will pay less attention to them. It is seldom that a motor is installed without consultation with some of the station employees, as otherwise the purchaser would be unable to secure the proper information to enable him to place order intelligently, therefore the central station has available the unsolicited opportunity to further its own interests to the advantage of the customer. The dealer's sole interest in the matter, in most cases, is his profit on the sale, and the larger the motor, the larger the profit. His interest in the adaptability of the purchased motor is much less vital than is the central station's. On the other hand, every dealer who can be interested in the sale of motors adds another solicitor to the station without any increase in expense. It is, therefore, in the line of good judgment for the central station to make a working agreement with every concern in his territory that has facilities for marketing motors, or other current-consuming devices, whereby the dealers will profit by inducing the prospect to deal with the central station. Let me illustrate this by selecting a community in which is established a live central station, prepared to furnish current on an economical basis for any electric-current-consuming device. There are located in this community two hardware dealers, two concerns engaged in general electric supply and wiring business, a concern selling gas and electric fixtures, a stove store, a tin store, four leading grocery stores and a half-dozen cigar stores. A representative of the central station (the manager, if you please) calls upon the representatives of these seventeen concerns and explains to them that the success of his business is dependent on the purchase and use by the community of goods that the dealer has always felt it unwise to carry in stock, as the volume of business would not insure an equitable return on the investment, the success of which would depend largely upon technical knowledge not available. The central-station representative assumes the position that it is the appreciation of these conditions which warrants his call, and arranges with the dealer to act as his agent. He purchases and supplies each with samples of such current-consuming devices as are applicable to his individual business, such as small motor, fan motor, flat-iron, coffee percolator, chafing dish, curling iron, corn popper, cooking devices, cigar lighter, and so forth. He makes arrangements to carry a small stock of these goods to enable him to fill orders promptly, and, not wishing himself to profit from the sale of these devices, allows the agent the difference between the net purchase price and the retail price, and protects him. The dealer, as he gains experience in the line, effects sales, or, in case questions arise with which he is unable to cope, refers the prospect to the central station, which, in effecting a sale, credits the dealer with his commission. In the event of a prospect coming direct to the central station to purchase a motor or other piece of apparatus and not taking kindly to being referred to a dealer, sell him and divide the profit, crediting a proportionate part to each agent. To be sure, this is easy money for the dealers and it won't take them long to realize it, and it will be easy to the station. Besides the business derived, you have seventeen earnest friends in the community, meeting most of the inhabitants, whose interest it is to impress on everybody what a public benefactor the station is; it makes the city contract come easier, it makes all your business relations pleasanter, and it increases your output. Think it over.

Chas. B. Burleigh.

Yes, practically at cost.

J. A. Lane.

As you are more interested than any one else in securing a day load, by all means yes.

J. H. Enright.

I believe it is.

F. C. Sargent.

In small plants it is usually necessary to do so in order to get the business.

R. H. Garrison.

Yes.

The Pueblo and Suburban Traction and Lighting Co.

Yes. No contractor has the same interest in following up power business as has the central station. But don't make the mistake of selling at cost. Cheapness alone is not a good argument, and motors may be sold at a fair profit and still compare favorably in price with gas or steam-engine installations.

When the central station sells motors it should have the wiring done by the local contractors, even when the motors are installed free.

Have it understood that when a contractor turns over to you an order for a motor that contractor gets the job of installing the motor.

E. C. Stahl, Jr.

We have found it good practice to sell motors, provided the best possible motor is sold at a reasonable profit and on terms that will enable a small customer to get started without too large an original investment. As a rule, where local contractors sell motors they are much more likely to deal in an inferior motor and to get the same price for it as for the high-grade machine. The lighting company, knowing the conditions, is better enabled to furnish exactly what is needed for customers' use.

Fred Leslie.

We have made it a practice for some years and believe it is a good policy. We have built up a large power business and, personally, I believe it has been due to some extent to the fact that we were able to furnish motors and install them, doing the engineering work necessary in an efficient manner.

E. W. Lloyd.

It is good practice for an electric company to sell any current-consuming appliance that the customer may use. Such equipment can be sold to the advantage of the customer and of the company on deferred-payment (hire-purchase) plan, the monthly payments being called in the contract "rental." The customer is thus acquiring an increased equity in the equipment and is likely to bestow much more thoughtful care upon its use and maintenance than if the appliances were loaned.

Douglass Burnett.

Yes, in order to insure prompt delivery.

F. Ellwood Smith.

No, because the company does not obtain the hearty cooperation of the manufacturers and agents handling motors. It would also be an additional expense.

H. L. Montgomery.

Yes, for the reason that the consumer could be approached with a fixed price. The company handles other forms of appliances, and I can not see how it would be more expensive to handle motors than transformers.

Harold J. Buell.

Y 7. Does the introduction of a fan or small motor for a special purpose usually act as an entering wedge for lighting business?

We have not found them of much help in securing lighting business.

Ludwig Kemper.

I believe so—use begets use.

C. R. Price.

Yes.

J. H. Enright.

I believe it does, as some people are so sceptical that until they are obliged to have a piece of apparatus they do not know the real benefit obtained from its use.

F. C. Sargent.

It does in the majority of cases.

R. H. Garrison.

We think so.

The Pueblo and Suburban Traction and Lighting Co.

The fan or small motor, or any other class of electrical equipment that can be introduced, is a good solicitor for lighting business and for the other uses of electricity.

Fred Leslie.

The intent of the fan policy outlined in my replies to Y 1 and Y 2 is not only to provide for the summer fan business that may be secured, but also to provide an entering wedge for the regular service, which does not require the special attention demanded of the summer contracts.

Douglass Burnett.

It does. Our fan and power rates usually make friendly consumers who are willing to listen to any new proposition.

Clifford Brown.

Y 8. Is the installation of small motors on residence circuits desirable or profitable?

Yes, for the same reason as given in answer to preceding question.

C. R. Price.

It is both desirable and profitable, but to give satisfaction the motors should be used during daylight hours only.

H. Clyde Parrish.

I think this business is desirable and profitable, as the current required is generally used during the daytime and not on peak load.

F. C. Sargent.

Only for popularizing the use of electricity.

The Pueblo and Suburban Traction and Lighting Co.

Small motors in the residence districts are profitable not so much because of the amount of current used as because of the additional business gathered in on their account.

Fred Leslie.

We allow the installation of small motors on residence circuits, and believe it is profitable business and that it has a tendency to advertise the use of electricity for different purposes.

E. W. Lloyd.

Yes, for it not only adds to our income but popularizes the use of electricity. The motors should be of such size and construction and used in such a manner as not to interfere with good lighting service.

F. Ellwood Smith.

It depends a great deal upon local conditions. It is the aim of the central stations to have an evenly-balanced load and where these motors are installed they must be thrown off the circuit at 5 o'clock, thus not interfering with the lighting load. In this way they are both desirable and profitable.

A. W. Hahn.

Yes; it increases the day load.

W. A. Carter.

Y 9. Is it not foolish to sell motors, such as family sewing-machine motors, at cost when the possible revenue is very low?

With other service, every little helps.

C. R. Price.

Yes. Motors of all kinds should be sold at a nominal profit.

J. H. Enright.

It certainly is foolish to sell at cost any apparatus having as small consumption of "juice" as sewing-machine motors. It would pay the central station better to give away flat-irons free of charge than to sell sewing-machine motors at cost.

Edward Peterson.

See answer to Y 8.

F. C. Sargent.

I consider it so.

E. R. Davenport.

Small motors popularize the use of electricity.

The Pueblo and Suburban Traction and Lighting Co.

Do not believe it is good policy to sell small motors at actual cost, but if they can be installed at a small profit they are surely a good booster for more business, and what little current is consumed is used in the daytime and scarcely ever during the peak load.

Fred Leslie.

We do not think it necessary to sell small household motors at cost, as we can just as well sell them at a small margin of profit. We believe in pushing this line of business because every article using electric current helps to advertise our business and increase our revenue.

E. W. Lloyd.

Personally, I do not think it is foolish, as they come on the day load and are therefore good business; they also lead to other business.

E. M. Jackson.

Y 10. If the revenue from residence motors does not pay, do the indefinite benefits warrant the trouble of introduction, and what are these benefits?

Within reason, yes.

C. R. Price.

Believing that electric appliances will in the end bring a large revenue to companies from residence customers, the writer thinks that anything that will serve to make electricity popular in the household is worth spending time and money upon to get it introduced. It should lead to the sale of other appliances that will bring in better returns.

Alex. J. Campbell.

The revenue from residence motors must pay something, and as they induce a more general use of electricity in the home, the trouble of putting them out is surely warranted.

Fred Leslie.

We believe the revenue from residence motors does pay, not necessarily the income from a particular motor, but from the fact that any article using electric current is a good advertiser and helps increase the business in other directions.

E. W. Lloyd.

Yes, because you make electricity popular with the ladies and attractive to the men when they are at home and free from business cares.

F. Ellwood Smith.

Y 11. Is any station making a successful campaign for introducing small motors for washing machines in residences? As

this would save an actual outlay in labor each week, it should be an interesting application if practicable.

This has been done in Altoona, Pa.

C. R. Price.

It is practical to run a small washing machine by motor, and the arrangement makes a very satisfactory rig, from the user's standpoint. But the receipts from sale of "juice" are so small that it is not worth bothering with from the central-station man's point of view.

Edward Peterson.

We ran an advertisement in the newspapers for a few days and received from this source a great many inquiries, which we turned over to the "1900 Washer Company," whose machine we were advertising. This was some four or five months ago, and we still receive inquiries. I understand that quite a number of machines were sold from these replies. The reason for the large number of inquiries is due to the fact that we advertised it would cost 15 cents per month per tub, and that the motor could be used both for running the washing machine and for turning the wringer.

E. W. Lloyd.

Y 12. What special line of motors has been found easiest to introduce when starting a motor campaign? What line does your canvasser find easiest to talk, and what points seem to appeal most to the customer—convenience, economy or comfort?

Economy is the best talking point, but after using a motor for a while the owner is generally willing to state that convenience, cleanliness and comfort are also well worth something.

J. H. Enright.

We have found the best possible motor that can be obtained is the easiest one sold to our consumers, as it can be operated with economy and convenience and very seldom gives any trouble.

Fred Leslie.

Y 13. Should a central station rent electric motors, and, if so, should this apply only to large sizes, or should it also apply

to fan motors and ceiling fans, which are used for only a few weeks or months in a year?

No.

J. A. Lane.

I do not believe it is good policy for a central station to rent motors or any apparatus. It is an expensive business to take care of, from the writer's experience, and has not been found desirable.

F. C. Sargent.

Renting motors should apply only to the larger sizes.

E. R. Davenport.

Where we rent small motors we charge as rental one-twelfth of the cost of the motor per month.

The Pueblo and Suburban Traction and Lighting Co.

Think it good policy at times to rent electric motors, especially large sizes, but not fan motors and ceiling fans. The revenue derived from the use of the motors should determine the policy of renting them. The revenue from fan motors is small and the depreciation on them is great, which would prohibit renting them for any reasonable amount.

Fred Leslie.

We rent electric motors for short periods, either for the reason that there is a delay in furnishing new motors and we wish to get the business on our circuits, or to make a demonstration as to the cheapness, reliability and general convenience of electric power. We do not rent fan motors or ceiling fans, as we have not been able to figure out how this would be a paying proposition, especially in the North.

E. W. Lloyd.

Yes, under the proper restrictions and guarantees. Rentals should be used as a means to sell the motors. I do not think it is advisable to rent a motor for an indefinite time.

F. Ellwood Smith.

If local dealers can not carry necessary investment in motors for rental purposes, central station shoull do so. It assists greatly in obtaining power business.

B. J. Denman.

Y 14. What effect would free wiring have? Would it be any inducement to prospective customers?

We think it would.

J. A. Lane.

We have found it successful.

The Pueblo and Suburban Traction and Lighting Co.

Free wiring would be an inducement to a few customers, but do not think it good policy, as the consumer is likely to believe that the company would not do the wiring if it did not expect to get back the cost thereof in a short time from the sale of current.

Fred Leslie.

I believe the effect of free wiring would be detrimental to the net receipts of any company, for the reason that many contracts would be obtained that would be discontinued in a short time. It would help obtain contracts, but of the unprofitable kind, because people who can not pay for wiring can not pay for current.

H. Zimmerman.

Y 15. Would not free wiring of houses, and so forth, greatly interfere with the local contractors and jeopardize the company's interests?

Probably to a great extent.

J. A. Lane.

It has been our experience that the contractors are inactive in furthering central-station interests—except in new buildings. In order to get the business of the old houses we found it necessary to wire them, and did not consider the contractors, nor did we experience any jeopardizing of our interests.

The Pueblo and Suburban Traction and Lighting Co.

Free wiring would cause an ill-feeling among the contractors, and the company's interests would suffer a great deal more than the benefit derived from the free wiring. Good contractors are generally business-getters and can boost the company's interest as much as the solicitor can.

Fred Leslie.

Yes, because the contractors will not give their hearty co-operation, and it would be better for the company to allow the contractors to do the wiring.

J. F. Fugazzi.

Y 16. How do you encourage window lighting, outlining of buildings, and use of decorative signs?

We allow an extra 10-per cent discount on same, provided they are burned every night until 11 o'clock or later.

Ludwig Kemper.

Flat rates controlled by ourselves.

The Pueblo and Suburban Traction and Lighting Co.

Window lighting is encouraged by special advertising and our own office window. The use of decorative signs is encouraged by a special rate for sign lighting, by furnishing signs at cost to the consumer, and by special advertising freely used by the company.

Fred Leslie.

We have a regular rule for the installation of lights in windows in the outlying districts, as follows: We wire the top or side lights in windows, furnishing Wheeler reflectors, or their equivalent in other reflectors, and agree to paint a 10-inch single-line sign across the front of said windows. This does not apply to signs in doorways or on the side of the building where no lights are used. The consumer pays the company $1.00 per lamp for the wiring, and agrees to guarantee a net minimum monthly bill of 25 cents for each light so wired on a concessional basis for one year. This price does not include the city inspection. If the consumer wishes trough lighting the price is $1.50 per light, not including city inspection. We furnish signs of three different designs free on a flat rate per week, taking contracts on a two-year basis, charging 5 cents per lamp per night from dusk to ten o'clock for 2-cp lamps, and 6.5 cents per lamp per night from dusk to twelve o'clock. This has enabled us to build up a very lucrative sign business, which is increasing very rapidly.

E. W. Lloyd.

Appeal to the merchants' pride in making the city beautiful. I believe all display lighting, even if put in for decorative purposes, is installed as an advertising medium. When the manager of any amusement company, park or gardens puts a great deal of money into decorative lighting, he puts it in for advertising effect. Instill in the prospect's mind that electric display lighting is no longer an experiment, but a guaranteed success. Quote some of the first-class business men in the city who have attributed their success in a great measure to display lighting. It is according to the spirit of the times, up to date, and will return money to his pocket.

G. E. Williamson.

Y 17. Do you do free wiring for store windows?

Only as a matter of competition.

The Pueblo and Suburban Traction and Lighting Co.

The answer to this question is the same as to Y 16.

E. W. Lloyd.

Y 18. Have you tried the plan of wiring houses and other buildings and taking payment in instalments? What success?

Yes, sir; good system, especially in manufacturing towns.

Ludwig Kemper.

Yes, successfully. The applicant's credit, however, is always investigated.

The Pueblo and Suburban Traction and Lighting Co.

Excellent success with regard to any class of wiring or equipment. See reply to Y 6.

Douglass Burnett.

Y 19. Is sufficient care and interest shown for new consumers after they have once been obtained?

We go to just as much trouble to please a customer after he is secured as we did when he was a prospect.

Ludwig Kemper.

Usually not.

J. A. Lane.

No. Satisfied customers are *the* most valuable asset, consequently it is of vital importance to retain them. Let the superintendent or agent see them often. Get intimately acquainted with your customers; learn their wants; use every honorable means to please them, and a feeling of mutual confidence will be inspired, eliminating the present popular prejudice.

Chas. G. Cook.

I think the policy of most central stations is to show very little interest in customers after they have once been obtained, but it is a well-known fact that central-station people are broadening out very much in their ideas upon this subject, and are displaying much more interest in their present customers than they did formerly, which, to my mind, is most desirable, as your present customers can assist you immensely in obtaining new customers. Only by displaying an interest in them can you keep them well satisfied.

F. C. Sargent.

That depends on the company—also on what your judgment dictates as being sufficient care.

Douglass Burnett.

I think they are too frequently neglected.

The Pueblo and Suburban Traction and Lighting Co.

Y 20. What is the most successful method used to meet the competition of the F. and P. gasolene-lighting system?

We have found GEM units and other high-efficiency lamps a great help. We also hammer along on fire danger, insurance, odor, and mantle cost.

Ludwig Kemper.

We have been successful in competing with gasolene lighting by the use of Harter clusters and tantalum lamps. The clusters are installed free of charge and the lighting furnished on a flat-rate basis at a cost that does not greatly exceed that of gasolene and cost of keeping up the system.

Fred Leslie.

Y 21. What methods do you use to close down isolated plants where steam heat is required?

We have a steam-heating system in connection with our lighting plant and have found that by furnishing the steam heat at our regular rates we are able to close down most of the isolated plants.

Fred Leslie.

The answer to this question would fill a book. It requires men of experience, the proper figures, and a knowledge of the conditions. In all large cities the central-station companies have to contend with this competition, and a perusal of the bulletins of any of the large central-station companies should convince you that this work can be done and is being done every day.

E. W. Lloyd.

Y 22. In a city of 15,000 population is 2-phase or 3-phase distribution preferable?

I should recommend a 3-phase distribution.

F. C. Sargent.

Y 23. What is the advantage of the combination of an ice plant with an electric light plant, especially in smaller communities?

There are many advantages in the combination of electric light and ice plants in small towns. As the same power is used for both plants, the operating cost is only slightly higher for both plants than for one, and, day current being necessary, the same attendants can successfully operate both departments.

Union Central Lt. and Ice Co.

Y 24. To what extent is it advisable to carry the practice of keeping spare parts on hand? Cite instances in your own practice, stating equipment and parts carried.

Y 25. When a company is supplying both gas and electricity in a given district, is it better to have a superintendent for each department or to have one man for superintendent of both departments?

It depends on the size of the company and the ability of the man.

C. R. Price.

One, if a small town.

J. A. Lane.

I believe it is better to have a superintendent for each department. In nine cases out of ten, it would tend to promote a higher efficiency in results.

F. C. Sargent.

Y 26. Please state whether any member has inaugurated a successful merit system to keep the work of employees at a high standard of efficiency and satisfaction. Give details.

We have a system for following up each branch of the solicitor's work. Each solicitor is given a quota at the beginning of the year which he is expected to get. After the power solicitor has contracted 75 per cent of the quota he receives a commission of one cent per 16-cp lamp equivalent, and in addition to this 50 cents for each contract. After the lighting solicitor has contracted 80 per cent of the quota he receives a commission of one cent for each 16-cp lamp equivalent and 50 cents for each contract. The above commissions are paid in addition to a regular salary.

Notwithstanding the fact that these quotas are laid out on a monthly basis, so that the solicitor has an object to work for each month, a maximum is set which the solicitor can not exceed. This system gives us a check on what the solicitor is doing at all times. It also makes the solicitor anxious to have his business connected so that he can make a settlement for the month and get the money due him.

We know that this system greatly reduces our unconnected contracted business and puts it on our system, whereby it becomes an earning power.

Our sign solicitors are on an entirely different basis. They receive a salary, and in addition to this salary they receive the first week's income from the signs. With seven men we get approximately 100 signs per month, and these signs increase our income each month at the rate of $20,000 per year.

We have a system for following up all contracts from the time they are turned in to this office by the solicitors, until the time the customer has the service installed complete. This is done by means of the card system. On the back of a card is stamped the time when the contract is turned over to the department that has the duty of executing the order. After the contract has been turned in to the contract department by the solicitors, the clerk goes to the department that has the order to execute, to find out when connection can be made. This is put on the card so the clerk can follow it up on that date.

We also have a system whereby each telephone call is made out in duplicate, charging it up to the solicitor, who is to execute this call and follow it up day by day.

We have a similar system for following up all letters that come through the mails. The letter is filed under the solicitor's name and he is given a copy of the details in the letter. If these letters are not reported on in two or three days, a second notice is sent to the solicitor asking a reason for the delay. The solicitor receives each morning a copy of all requests for cutoffs in his district; he is expected to call on each one of these parties and see if the business can not be kept on the system.

It is the policy of this company to follow up everything, so as to give the customer the best of service, and to enable the company to begin to receive a revenue as promptly as possible.

E. W. Lloyd.

Y 27. Is the electric lighting business adapted to any scheme of profit-sharing with employees? What plan is best? What has been your experience?

Y 28. Would it pay large companies to invest money in timber land for the purpose of cultivating trees for poles?

Y 29. What can be done to promote uniformity in interpretation of insurance rules concerning wiring installation, by inspectors of the Underwriters' Association?

Apparently nothing by central-station men, as each inspector interprets the rules according to his own conception and often according to circumstances, we find.

J. A. Lane.

Periodical meetings of the representatives of the Underwriters' Association, the local contractors and the company, at which "talks" may be had, questions asked and answered, insurance rules discussed and explained, for the better understanding of all concerned.

Chas. G. Cook.

Y 30. Assuming a residence to be equipped with concealed wiring that has been condemned by the insurance inspector, and the house has been rewired entirely independent of the condemned system, is there any valid reason why a certificate should be refused until the old wiring is completely removed?

It certainly is unreasonable for an insurance inspector to demand the removal of old and unused concealed wiring where the building has been recently wired in an approved manner. This is in many cases impossible, and, where possible, most expensive. Of course, the new wiring should be run free from the old wiring and carefully insulated. The inspector should be content if the old wires are cut off close to the outlet, and if possible the old outlets closed up. This same case has come within my experience, but the chief inspector of the Underwriters showed good judgment by not insisting on the old wiring being removed where the new wiring was approved and the old wiring cut out absolutely.

John McFeeley.

No.

J. A. Lane.

Z—LEGAL

Z 1. In case you have among your printed rules one like this—"If all bills are not paid on or before the 15th day of the month in which they become due, service will be cut off without notice"—do you strictly enforce it? If not, what legal bearing would it have in case you cut out a customer where there was a dispute or controversy?

Think it would be better to change this rule.

C. R. Price.

I do not believe in having rules that are not enforced. However, such rules as the one in question are intended as a protection against dead-beats and those who refuse absolutely to pay a correct bill. It is poor policy to cut off any consumer without notice, and when it is done the company's ground should be well taken.

J. H. Enright.

If you have such a rule, why not enforce it strictly, but with moderation? For example, it would be possible to send a man around to say that he has an order to disconnect the meter, but that he will delay doing so until that afternoon or the next day; thus giving the customer a chance to pay his bill, while the company has lived up to its rules and regulations. It is doubtful if any rule has legal force unless it is part of a contract signed and agreed to in advance by the customer.

Alex. J. Campbell.

The notice on our bill reads "Service *may* be cut off."

The Pueblo and Suburban Traction and Lighting Co.

Change the word "will" to *may*.

F. Ellwood Smith.

Z 2. In case a person or company held a 20-year franchise and at the expiration of its term the city refused to grant a new franchise, could the city compel the holder to cease operations or remove the lines from the streets without compensation?

No.

J. A. Lane.

I do not think so. If your franchise has expired the city is under no further obligations to you, and can grant your company or some one else another franchise. I do not believe it can compel you to suspend operation, as such a course would destroy your property, and our courts are not in the business of legalizing the destruction of property.

J. H. Enright.

Z 3. Assuming that the operating company has inspected a wiring installation and approved of it, and a fire takes place caused by current from the company's lines, what would be the company's

position? Assuming that a city officer had passed the same installation, would the company be in any better position as to liability for damages? Similarly, if it was passed by an Underwriters' inspector?

In the case of Guardian Fire Association *versus* Quebec Railway, Light and Power Company, for damages from a fire by a breakdown of a transformer, the insurance company lost the case because the lighting company proved that the wiring of the building destroyed had been improperly done and was not according to regulations, which would almost indicate that it was safer not to approve or pass wiring.

R. N. Robins.

The company should hardly assume the responsibility of passing on it. It would help the situation if passed by an Underwriters' inspector, and it should relieve the company entirely.

J. A. Lane.

†—UNCLASSIFIED

1. Is there any electrochemical process the product of which could be manufactured on a profitable basis by electric lighting companies, utilizing for this purpose the spare capacity available at low-load hours?

2. Give average wages of chief engineer, assistants and firemen in 500-kw to 800-kw plants—especially in middle states.

Chief engineer, \$65 to \$75; assistant engineer, \$55 to \$60; firemen, \$45 to \$50. All for labor working 12-hour shifts.

Ludwig Kemper.

3. Is it customary to test the insulation resistance of house wiring where the work is done with approved materials and in a satisfactory manner? What is the best type of instrument for such work?

It is customary to do nothing more than to test out for grounds and short-circuits with a magneto.

John Cyrus Distler.

4. Does alternating current cause electrolysis?

Not to any extent.

J. A. Lane.

Yes, but very slight as compared with direct-current electrolysis. This subject is very well discussed in the transactions of the American Institute of Electrical Engineers for February, 1907.

B. E. Morrow.

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BUILDINGS

QUESTION

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A 2 Does concrete construction pay on large buildings with considerable height?—p. 3.

A 3 Is concrete piling satisfactory? How does cost compare with wood piling?—p. 4.

A 4 Is it safe to do concrete work in the winter-time in cold climates? What will prevent the concrete from freezing and crumbling?—p. 4.

A 5 What kind of roof is advisable for a fireproof plant?—p. 6.

A 6 Has a satisfactory treatment been found to render cement floors dust-free and oil and waterproof?—p. 6.

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A 8 What is the best size of crushed stone to use in 12-inch concrete tunnel-walls supporting roof 12 inches thick with 5-foot span reinforced with expanded metal 2 inches from bottom of roofing, the whole structure designed to stand 4000 pounds pressure per square foot? What proportions should be used for best construction for the size of stone chosen?—p. 8.

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B 2 Can any one give reasonably accurate figures on the cost of maintaining a low-head water-power installation of, say, 8 to 10-foot head?—p. 11.

B 3 What is a fair depreciation allowable on a low-head water-power installation of, say, 8 to 10-foot head?—p. 12.

B 4 What is correct average cost per horse-power per year of repairs to water-wheels, flumes, tail-races, and shafting to driving gear, of water-power installations of low-head, say 8 to 10 feet?—p. 12.

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B 5 Suggest scheme for the prevention of anchor ice common in the rivers and streams of this section of the country (Michigan). —p. 12.

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C

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C 1 In taking water from river for boiler-feed pumps, is there any standard method of building the suction inlet so as to obtain clear water, free from sand, leaves, and so forth?—p. 13.

C 2 Boiler feed-water is impregnated with tar from a near-by water-gas plant. What effect, in time, will the tar have on the feed-pipe, pump, valves, boilers and engine cylinders? What is the best method of extracting the tar from the water?—p. 15.

C 3 Explain action of boiler compound when placed in an open heater. How should it be fed into the heater?—p. 16.

C 4 Soda-ash does the same work in our boiler as prepared compound containing soda-ash and common salt. Will the ash, alone, have any injurious effect, and if not, what is the salt for?—p. 18.

C 5 In good practice, what percentage of the total power generated is required for operating—(a) Circulating pumps? (b) Air-pumps? (c) Oil-feed pumps? (d) Exciters? (e) Coal-handling apparatus?—p. 19.

C 6 Does gain in economy by use of economizers compensate for added complexity and cost of repairs?—p. 20.

C 7 What has been the experience as to cost of maintenance of economizers per boiler-horse-power in good-sized installations? —p. 20.

C 8 Are recording thermometers sufficiently accurate to justify their use in recording temperature of boiler feed-water when thermometer is placed 100 feet from and 15 feet above point of connection to feed-pipe?—p. 20.

C 9 Give reference to best literature on construction and operation of centrifugal pumps.—p. 21.

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D 1 Has anything been done in this country, outside of municipal plants, in the use of garbage as fuel?—p. 21

D 2 What is the most economical method of generating gas for power plants?—p. 21.

D 3 State value of oil as compared with wood and coal for fuel purposes.—p. 21.

D 4 What practical results in economy have been obtained by the use of a mixture of bituminous and No. 3 buckwheat coal?—p. 21.

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D 5 The Western Electric Company, in its descriptive catalogue on Hawthorne Works, page 7, makes the following statement: "Carefully executed tests in Europe show that nearly 30 per cent of the heating value of coal is lost in six weeks when exposed to the air. By keeping the bins flooded the company expects to reduce the losses of the coal to approximately two per cent of its heating value after six months to a year storage." Are these statements verified in the experience of the members of this association?—p. 21.

E

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E 2 What is the cheapest method of holding steam on boilers as reserve against high-tension transmission breakdowns? Banked fires take too much coal, make dirty fires and allow steam to drop. Small auxiliary boiler piped to the main boilers has been suggested, also temporary narrowing-up of fire-box of boilers so as to allow of small live fire being kept.—p. 25.

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F 2 Are steam blowers with shaking grates found to be economical? —p. 33

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F 3 What is the best method to hasten steaming on auxiliary boilers? —p. 36.
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F 7 What are the principal advantages of a concrete stack?—p. 40.

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G 2 What is the best material for oil piping in a large oil-circulating system in parts of which the oil may have a temperature of 120 degrees Fahrenheit? Why is plain iron piping objectionable for this purpose? Will pipe galvanized inside answer?—p. 40.
G 3 What is the best material for making tight joints in oil piping? —p. 41.
G 4 What is the best kind of gasket for pipe flanges where there is considerable vibration at a pressure of 140 pounds maximum? Rubber lasts only a short time.—p. 41.
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G 6 If the condenser (jet) is placed 30 feet from the low-pressure cylinder, will the vacuum gauge placed on condenser head show less vacuum at this point than at a point midway between low-pressure cylinder and condenser head?—p. 42.
G 7 Would a vacuum pump at the end of a series of one-inch pipes for heating a building be of any benefit in helping the exhaust steam through pipes before condensation takes place, when there is a six-pound back-pressure on the exhaust?—p. 42.
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G 9 What is relative power taken by auxiliaries when surface condensers are used and when using barometric column condensers?—p. 43.
G 10 Without economizers, which units of a surface-condensing outfit should be operated by motors, and which by steam units?—p. 43.

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G 11 What is the best literature on the subject of barometric condensers?—p. 44.

G 12 Give some good practical applications of the steam accumulator (Rateau, for instance), and give reasons for same, based on actual results.—p. 44.

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H 3 What has been the experience with the Diesel oil engine? Has it proved to be more economical than the Corliss engine? Is it thoroughly reliable?—p. 45.

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H 5 What is the most satisfactory method of arranging apparatus for indicating a vertical multi-cylinder gas engine with enclosed crank-case?—p. 46.

H 6 Taking it for granted that the producer-gas engine is the most economical motive power of to-day so far as fuel consumption is concerned, what is the relative maintenance cost per kilowatt-hour of a gas-producer plant, reciprocating engine, steam turbine, and gas engine?—p. 46.

I

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I 2 What is the difference of economy between a reciprocating engine, Atlas type, and a Curtis turbine, 5000-kw units, at their normal load; also the difference in pounds of steam between normal and light loads?—p. 48.

I 3 Does it pay to install turbines in units of about 500-kw capacity, compared with compound-condensing Corliss engines?—p. 49.

I 4 What difference in steam economy has been found, in practice, between new turbines and the same turbines after running 10,000 hours or more under load of three-quarters rated capacity or over—(a) in Parsons type? (b) in Curtis type? Give size of units.—p. 50.

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I 5 Boiler makers claim that from 10 to 12 per cent extra fuel is required to obtain 150 degrees superheat. Turbine builders give practically the same percentage in steam economy. Where, then, is the advantage in using superheat?—p. 51.

I 6 What is the known difference in efficiency of the station where reciprocating engine exhausts direct into condenser and where the reciprocating engine exhausts into low-pressure turbine, which then exhausts into condenser?—p. 52.

I 7 What results have been obtained, so far as economy is concerned, with turbines operating with the exhaust from other units? —p. 52.

I 8 Using a brass-coil, iron-shell, feed-water heater as an oil-cooler for a Parsons turbine oiling system, should the oil be in the body of the heater or in the tubes, and why?—p. 52.

I 9 What are the essential qualities of a proper oil for use on bearings of steam turbines of the Parsons type?—p. 53.

I 10 What are the essential qualities of oil to be used on primary valve of Parsons' turbine when steam of 150 pounds pressure and 150 degrees superheat is used, and what is the best method of feeding the oil to prevent sticking of pilot valve?—p. 53.

J

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J 1 Is there a company operating a combination of steam-heating and electric plant, using coal entirely or in part, competing successfully with an electric plant operating from water-power? If so, what are the rates of the water-power company?—p. 53.

J 2 Do you recommend auxiliary heating plants to be operated by steam or by hot water?—p. 54.

J 3 Can steam be used to heat water for domestic use, for swimming pools, and so forth? If so, how, and in what manner should charges be made?—p. 56.

J 4 Can steam be used to heat the water for circulation in a system piped for heating by hot water? If so, how? How should the service be charged for?—p. 57.

J 5 Is practically any difference noticed in the effective heating at a given pressure when exhaust steam is used and when live steam is supplied through a reducing valve?—p. 58.

J 6 Can you give a brief description of piping under the atmospheric system?—p. 59.

J 7 What are the advantages to the consumer, also to the company, in having buildings piped for and heated by the atmospheric system?—p. 60.

J 8 Why is less steam required to heat a building piped under the so-called atmospheric system of piping than where piped under the one or two-pipe steam systems or the vacuum systems? —p. 61.

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J 9 Why is less fuel required to operate the heating plant and the electric plant together, using the exhaust steam for heating, than is required in the operation of the heating plant alone, using direct steam, at which time the usual fuel is also required to operate the electric plant independently? Is it due to a higher value of the steam because it is exhaust, or is it due to better boiler efficiency on account of the continually interrupted flow of steam from the boilers through the reciprocating type of engines and into the heating system, as against the uninterrupted flow of steam through a stationary reducing valve located between the boilers and the heating system? In the above question it is assumed that the generating of steam in the boilers is at the same pressure in both cases. Is there any other reason why such results are obtained? Give experience, if possible. —p. 62.

J 10 (a) How much more steam per horse-power, or per kilowatt, is required by engines per pound of back pressure as against exhausting to atmosphere? (b) As against operating under vacuum?—p. 64.

J 11 Is a cumulative sliding scale of meter rates the best method of charging for heating service (a) in business, manufacturing and public buildings; (b) in residence heating?—p. 64.

J 12 What meter rate will approximately correspond with a flat rate per square foot of radiating surface? Is the meter rate better for small plants?—p. 66.

J 13 What is the ratio of average demand per season to maximum demand in district steam-heating plant?—p. 67.

J 14 What is the shape of the daily load curve in district steam-heating plant for business district? For residence districts?—p. 67.

J 15 What proportion of live steam have you found necessary? State maximum electric load and maximum demand for steam for heating purposes.—p. 67.

J 16 Where exhaust steam is used for district heating what portion of the power-house expenses should be charged against the steam-heat business?—p. 67.

J 17 In a district heating plant or a plant that furnishes steam for heating a few buildings only, what is the best method of getting at rate of charges for heat consumers of steam?—p. 71.

J 18 What is the best method of subdividing revenue received from each individual building where heat, light and power are furnished under a flat-rate charge covering the three commodities? Should recording wattmeters be placed on both the lighting and power circuits and a steam-condensation meter on the heating system, and a proportionate credit be given to each class of service in comparison with the regular meter rates for light, for power and for steam heat, or should the heating branch of the enterprise be credited with the full amount as shown by

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meter, and balance received from the consumer be subdivided between the power and lighting accounts?—p. 71.

J 19 Is there a reliable steam meter on the market?—p. 72.

J 20 (a) What is your system of charging for steam heat? (b) What are your steam-heating rates? (c) Do you find the steam-heating business profitable?—p. 72.

K

GENERATORS AND EXCITERS

K 1 In an extensive system to best insure continuity of service and at the same time not make an unreasonable investment charge at any time, what ratio should exist between the generating capacity and the actual maximum load carried?—p. 73.

K 2 How much greater capacity, if any, should the distributing system have than the generating system?—p. 74.

K 3 In connection with a rotary-converter equipment employing regulators, what has been observed to be the limiting feature concerning maximum capacity of same?—p. 75.

K 4 In cases where the regular operating procedure of shutting down a rotary-converter unit equipped with an induction regulator provides for opening the fields of the converter before it comes to rest, has trouble been frequently experienced in subsequently starting the converter from the direct-current end, due to the residual magnetic condition of the static transformer?—p. 75.

K 5 What has been the experience of large companies operating numerous large rotary converters as to the comparative merits of staggering every other set of direct-current carbon brushes on direct-current side with reference to each other, or of staggering by groups of adjacent positive and negative brushes with reference to each other, the latter method of staggering being done for the purpose of avoiding the uneven wear on the commutator due to electrolytic deposition of copper on the face of the positive carbon brushes from the copper commutator immediately under the brush face?—p. 75.

K 6 What has been the experience of those who have used in practical work a system of automatic synchronizing of rotary converters? —p. 76.

K 7 In compound-wound rotary converters do the results obtained with series reactances justify their installation? What maximum per cent of over-compounding can be secured in practical operation by their use, and what method of operation of the rotary-converter set, as regards suitable power-factor for mean loads, gives best results?—p. 76.

K 8 Why not use compounding rotaries in light and power substations? —p. 77.

K 9 In operating several high-voltage 3-phase generators in parallel, is it desirable to ground the neutral of more than one generator? —p. 77.

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K 10 Is it now considered the best practice to ground the frame of any generator of a potential sufficiently high to be dangerous to life?—p. 77.

K 11 Is a very close speed-regulation of prime movers desirable in the parallel operation of alternators?—p. 78.

K 12 Assuming two or more alternating-current generators feeding into a common 'bus-bar without automatic circuit-opening devices in the leads from the individual generators, what would happen (a) if, for any reason, the field of one generator should die out, (b) if the operation of an automatic speed-limit device should shut off the steam from one of the generators?—p. 78.

K 13 What will be the effect of running our 3-phase alternators unbalanced? We have two 200-kw, 3-phase machines, both direct-connected to one wheel shaft. One alternator then has practically only two legs in use, transmitting current at 11,000 volts twelve miles, the other single-phase; the other alternator transmitting current ten miles at same voltage 3-phase.—p. 80.

K 14 In two lighting circuits running from one 140-cycle, single-phase, compound-wound alternator, with amperage equal on both circuits, the pressure differs from two to four volts. What causes it?—p. 81.

K 15 What experience have central stations had with Tirrill or Chapman voltage regulators on inductor alternators, belted, load being induction motors and lights?—p. 81.

K 16 Explain how a synchronous motor takes up the induction on a transmission line and whether it takes more induction running idle or under load.—p. 82.

K 17 Will some one give a definition or explanation of the term "phase" as used in alternating-current work, so it can be made clear to the ordinary non-technical customer?—p. 84.

K 18 Give a short explanation of the necessity for a large air-gap in turbine generators.—p. 85.

K 19 In changing from Brush lamps, 9.6-ampere, to magnetite lamps, which is the better—to use mercury-arc rectifiers or rewind Brush machines?—p. 86.

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K 23 If two generators, one of 650 volts and the other 625 volts, were connected up in parallel, what would be necessary to make them equalize properly, provided the machines were equalizing on negative side?—p. 88.

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K 24 What are the advantages and disadvantages of using equalizing connections on the negative polarity of compound-wound direct-current generators for railway service?—p. 89.

K 25 In an exciter system, which are more satisfactory—compound or shunt-wound generators, there being no battery in the system? —p. 89.

K 26 In putting a generator out of service, to how low a value is it customary to carry the voltage (that is, what percentage of normal voltage) before breaking the fields?—p. 90.

K 27 When and how frequently do station engineers need to reduce the voltage of a generator to as low as one-half the normal no-load value?—p. 91.

K 28 How much power is gained by direct-connecting instead of belt-driving?—p. 91.

K 29 What is the best metal for bearings on dynamos?—p. 91.

K 30 What are the objections, if any, to using air suction instead of air blast for cleaning electrical apparatus?—p. 92.

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L 2 How does bulk compare with capacity in storage batteries?—p. 93.

L 3 What is the average life of positive plates in terms of equivalent complete discharges?—p. 93.

L 4 What should be the loss in capacity of a storage battery kept in first-class condition, after (a) twelve months' use, (b) two years', (c) three years'?—p. 94.

L 5 What experience have you had with the tray-plate style of storage batteries, and what are its advantages?—p. 94.

L 6 A 500-kw generator (550-volt) is sufficient to pull the street-railway load, except for a period of two hours per day when we have a peak load of 300 amperes above machine capacity. What is the general procedure in calculating for a storage battery and booster outfit to take care of this peak? Give size of battery and booster, explain function of each, and show how you arrive at results.—p. 94.

L 7 Explain tests for electrolyte of storage battery.—p. 96.

L 8 Who makes a good, cheap still for making about three gallons of water per day?—p. 98.

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M 2 Should transformers, switchboards and apparatus be placed in groups indicating the kind of service they perform—street service, commercial, multiple service, and so forth—or should they be placed, say, all switchboards in one group and transformers separately, so as to facilitate the work of the substation attendant, giving him a chance to look over the total service at one glance? In which case is the wiring simplest?—p. 99.

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M 4 Is it preferable to use bare copper wire for inside wiring on high-tension transmission work, and, if so, why?—p. 101.

M 5 Should barriers be used in preference to large clearances? How does first cost of installing barriers compare with first cost of constructing the larger building required by the larger clearances?—p. 102.

M 6 Modern switchboard practice seems to exclude every kind of automatic circuit-opening device between generators and 'bus-bars. Why is this done?—p. 102.

M 7 Should oil switches, provided with automatic circuit-breakers connecting individual lighting and power feeders to a common 'bus-bar of a 2300-volt alternating-current distribution system, be equipped with disconnecting switches, so as to provide a ready means for examination and repair of the oil switch without disturbing the rest of the feeders?—p. 104.

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M 10 In wiring from generator to switchboard for 2-phase work, is it better to use a conduit for each phase or to put all four wires in a single conduit?—p. 105.

M 11 With 2300-volt, 3-phase, 60-cycle generators, which is considered the best practice for connecting the generator with the switchboard—three-conductor lead-covered cables; three-conductor rubber-covered cables in conduit; three separate rubber-covered cables in one conduit, or three single-conductor lead-covered cables bunched together? There is not room to run single-conductor cables, each in its own conduit. The space under the floor where the cables run has more or less water in it during spring freshets. Explain Murry loop method.—p. 106.

M 12 In a small station of about 600-kilowatt capacity, 60-cycle, 3-phase, for mixed power and lighting load, is the use of three ammeters on generator panels, instead of one, worth the difference in cost? The power feeder panels are fitted with three ammeters; the lighting feeders, single-phase, with one each.—p. 106.

M 13 Which is better to install on alternating-current light and power

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M 15 Describe connections and action of the frequency indicator. —p. 108.

M 16 What method is used in testing for grounds with a millivoltmeter? How is result determined?—p. 110.

M 17 Is it advisable to tie-in Edison underground feeders solid at the station end or should they be fused? All mains are fused at junction boxes.—p. 111.

M 18 Describe any successful commercial installation of mercury-arc rectifiers used as lightning arresters.—p. 111.

M 19 Give best method of regulating voltage on distributing end of high-tension transmission line carrying both railway and lighting load.—p. 111.

M 20 What is the best arrangement of switchboard for plant of, say, 160-kw capacity, with two machines, and where the distribution of different circuits for the office building are to be on same board?—p. 112.

M 21 What has been the experience of central stations or power plants with regard to cables between generators and switchboard for alternating-current low-potential (500 volts or under) and large currents, say from 100 amperes up? (a) With duplex or three-wire cables in lead sheath? (b) Rubber-covered single-conductor cable? (c) Single-conductor cables with other insulation than rubber? (d) Have there been any known cases of trouble due to abrasion of insulation by drawing cables b and c through conduits? (e) Have there been any cases of trouble due to moisture? (f) Have there been any cases of fire?—p. 113.

M 22 In the case of a three-phase switchboard, what is the practice with regard to (a) mounting one or three ammeters on the generator and feeder panels; (b) two or three indicating wattmeters on the generator panels; (c) using a power-factor indicator to take the place of the indicating wattmeters?—p. 113.

M 23 What is the status of the alternating-current reverse relay?—p. 113.

M 24 Why does the National Electrical Code allow molding to be used for electric wires but condemn a wire touching wood anywhere else?—p. 114.

M 25 Is it advisable to attempt to insulate a switchboard gallery?—p. 114.

N

BELTS AND SHAFTING

N 1 What has been the general experience in actual measurement of static and running friction in the average industrial plants, such as textile mills, and so forth? In very modern installations I have found it largely in excess of allowances usually made by

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engineering authorities and the tables of the machinery dealers. —p. 114.

N 2 From a vertical hydraulic turbine where floor space is no object, is it better to run a quarter-twist belt to a horizontal line of shafting and belt this shaft to the generator, or to use a bevel gear and pinion to drive the horizontal shaft?—p. 115.

N 3 What is the correct shape for oil rings on brass bearings 3.75 by 15 inches?—p. 115.

N 4 Should the oil grooves in bearings run from rings to centre and end of bearing?—p. 115.

N 5 What can be done to insure against hot boxes on machines? —p. 115.

O

OIL AND WASTE

O 1 What are the maximum and minimum limits that good practice dictates for the amount of cylinder oil, of engine oil, and of waste, that may be used per unit in a plant of 500-kw units, 1000-kw units, and 1500-kw units? All direct-connected, condensing-engine generator sets.—p. 116.

O 2 Give a test or series of tests that may be applied without an extensive laboratory to determine a good cylinder oil and a good engine or dynamo oil.—p. 117.

O 3 Explain test for determining viscosity of machine lubricating oil. —p. 118.

O 4 In a lubricating oil, what is the relation of viscosity to the value of the oil as a lubricant?—p. 118.

O 5 In lubricating an engine cylinder is there any economy effected in feeding a smaller drop at more frequent intervals? If so, has it been successfully accomplished?—p. 118.

P

OVERHEAD LINES

P 1 Have creosoted poles been used to any extent, and have they proven as good as other poles?—p. 119.

P 2 Foreign practice having shown that the life of poles can be materially increased by proper impregnation, why is not this method more generally used in this country?—p. 119.

P 3 How much can the life of poles be prolonged by the best method of impregnation?—p. 120.

P 4 If by means of impregnation the life of a pole can be doubled, what percentage of increase in the price of the pole, due to the treatment, can be considered a good investment?—p. 121.

P 5 What results have been obtained in the treatment of poles to prevent decay at the top of the ground?—p. 121.

P 6 Have any serious accidents, due to greater liability to ground, occurred with creosoted poles?—p. 122.

QUESTION

P 7 Is there any objection to the use of creosoted poles in a small plant of about 400-kw capacity, operating twenty-four-hour service, when primary feeders are protected by line switches so that current can be cut off of any section of line when doing repair work?—p. 122.

P 8 What would be the average age of chestnut trees from which can be cut poles of the dimensions given in these specifications?—p. 123.

Length Over All in Feet	Minimum Circumference	
	Six Feet from Base	Top
30	37 inches	22 inches
35	41 "	22 "
40	44 "	22 "
45	47 "	22 "
50	50 "	22 "
55	53 "	22 "
60	57 "	22 "

P 9 Do the usual specifications given for butt and top dimensions of chestnut poles (see question No. 8) agree with the natural dimensions of the tree?—p. 124.

P 10 Should native western poles be cut when sap is up or when sap is down?—p. 124.

P 11 Please give your experience in the use of cypress poles, particularly cypress grown on high, dry ground.—p. 125.

P 12 Locust cross-arm pins being scarce and hard to get, what is taking their place?—p. 125.

P 13 Should pole-line hardware, such as bolts, coach screws, washers, cross-arm braces, anchor or ground rods, and so forth, be galvanized by the electrolytic process or by the hot-galvanized, or dipping, process?—p. 126.

P 14 In a transmission of moderate capacity, does the security against damage by lightning afforded by guard wires offset the expense and the liability of short-circuiting by fallen guards?—p. 127.

P 15 Do general results show that barbed wire over transmission line is really any protection against lightning?—p. 127.

P 16 What distance apart should lightning arresters be placed on 2300-volt lines in order to obtain the best protection?—p. 128.

P 17 In what parts of a transmission line having considerable difference in altitude do you find the most serious effects from lightning discharges?—p. 128.

P 18 Has any one any data on difference of potential between different parts of a transmission line, due to differences in altitude?—p. 128.

P 19 Are there any objections to putting high-tension wires (2300 volts) in lead sheaths for overhead work? If so what are they?—p. 128.

P 20 Considering cost and difficulty in making good joints, does aluminum show any advantages over copper for high-tension, long-distance transmission?—p. 130.

Question

P 21 Is there a line fuse-box made that is suitable for installation on a pole and will safely stand the blowing of larger than 30-ampere fuses on short-circuit on 2200-volt line?—p. 130.

P 22 Is it advisable to use patent screw anchors in preference to using a "deadman" for anchoring guy wires in electric light and power pole lines? What has been the practical experience with the former, especially in localities where the soil is adapted to their use?—p. 131.

P 23 (a) What method is employed in dead-ending heavy wires carrying current at 2300 volts? If strain insulators are used, describe them. (b) Ditto for 6600 volts.—p. 131.

P 24 Describe method of connecting underground services at 2300 volts to overhead lines. If terminal box is used for end of underground cable, give sketch or description.—p. 132.

P 25 Do you solder all joints in overhead lines?—p. 134.

P 26 What is the smallest wire you use on overhead lines?—p. 134.

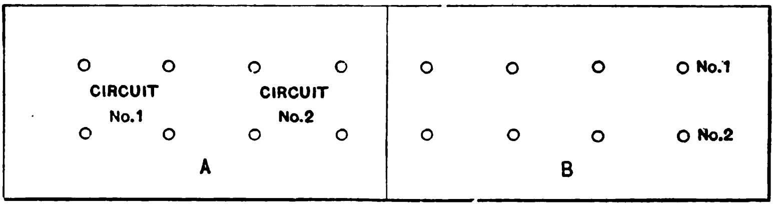
P 27 Has it been found practicable and profitable to revarnish insulation of overhead wires in position, for the purpose of preventing deterioration? If so, what coating was used and how was it applied?—p. 135.

P 28 What precautions should be used when tapping or repairing wires carrying 2000 volts?—p. 135.

P 29 Why has direct-current, high-tension transmission been practically neglected in the United States?—p. 136.

P 30 What are the advantages of the Y over the delta connection? Grounded and ungrounded neutral.—p. 136.

P 31 Which is the better way to construct two circuits, 2-phase, 4-wire, on one pole, diagram A or B, using two 4-pin cross-arms?—p. 138.



P 32 In line work how far apart should alternating-current wires be placed to get best results? Answer is desired in the form of a table (suitable for practical purposes) covering all standard voltages, current frequencies and power-factors.—p. 139.

P 33 What attention in the design of high-tension systems may eliminate the phenomen of resonance?—p. 139.

P 34 (a) Can a telephone line be successfully operated on same poles with 13,000-volt transmission lines at 60 cycles? (b) If so, what should be the space between transmission lines and telephone lines? (c) If open line, how often transposed?—p. 140.

QUESTION

P 35 On telephone lines running on the same towers or poles with high-potential transmission lines, has any difference been noted between the use of copper or iron for the telephone line; referring particularly to electrical conditions and not to mechanical strength of lines?—p. 141.

P 36 Has it been found satisfactory to operate distributing systems 3-phase, star-connected with the neutral grounded, in order to save cost on long lines and to get a higher voltage for transmission and still be able to use standard transformers?—p. 141.

P 37 In case of a 4-wire, 3-phase circuit, 100 volts between any phase, and the neutral and 173.2 volts between any two of the phase wires, if an unbalanced load is carried (for instance, if there is 20 amperes on A phase and 15 amperes on B phase and 10 amperes on C phase), does the neutral take care of all the return, or do the less heavily loaded phase wires as B and C take care of part of the excess from A?—p. 142..

P 38 We have a short line of 50-foot poles. On top we carry our 23,000-volt transmission line, two wires on a 30-inch cross-arm, the third wire on an insulator and pin driven in top of pole. Five feet below this cross-arm are nailed two Western Union brackets, one on each side of pole, which carry our private telephone line. Five feet below this we have four 4-pin cross-arms, 18 inches apart. The two top arms carry 2300-volt primaries and the two lower arms carry the 110-volt secondaries. Please describe any faults or dangers possible in this construction.—p. 143.

P 39 What is the practical maximum limit for distribution with 110-220-volt, 3-wire system, population and distance considered?—p. 144.

P 40 What are the respective advantages and disadvantages of the two following plans: (a) Generating and transmitting at 60 cycles, transforming to low tension at substation for distribution. (b) Generating and transmitting at 25 cycles and using motor-generators at substation to transform to 60 cycles, low tension, for distribution?—p. 144.

P 41 What success has been had with horn type of lightning arresters for high-tension lines?—p. 145.

P 42 About a year and a half ago we had some mysterious influences at work which resulted in the burning-out of a number of motors. The station instruments did not record any excessive voltage or amount of current, but within a week there were short-circuits, as above stated, in about a dozen motors located in different parts of the city. The appearance of the insulation of the armature was as if pricked by a lightning discharge, although the season was in December or January and we were equipped with lightning arresters.

I have been informed that companies using wireless apparatus have paid damages to supply companies on account of injuries

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to apparatus by high-potential discharges. Have any member companies had similar experience?—p. 149.

P 43 Give fair specification for cedar poles.—p. 151.

Q

UNDERGROUND LINES

Q 1 What objections can you offer to laying high and low tension conduits in a common trench?—p. 152.

Q 2 What is the maximum grade on which lead-covered cables can be installed in fire-clay ducts without special provision being made to prevent their slipping down?—p. 152.

Q 3 What is the best method of holding lead-covered cables, to prevent their slipping, when installed in fire-clay ducts?—p. 154.

Q 4 What member companies are using lead-covered cables for transmitting 60-cycle current underground at 10,000 volts or over?—p. 154.

Q 5 What member companies are using lead-covered cables for transmitting 25-cycles underground at 15,000 volts or over?—p. 155.

Q 6 How many systems with operating voltages higher than 20,000 volts employ underground cable for transmission purposes, and what success has been obtained?—p. 155.

Q 7 Is it practical to operate large underground, 60-cycle, alternating-current, secondary systems, using single-conductor lead-covered cable? If not, give reasons.—p. 155.

Q 8 What success has been obtained in using insulated cables, not lead-covered, in underground conduits (duct system) on voltages of 2500 to 5000?—p. 155.

Q 9 (a) In running a 2200-volt primary line underground, what precautions should be taken to prevent ground line? (b) What kind of wire should be used? (c) What kind of conduit?—p. 155.

Q 10 What is the best apparatus for making potential test of underground cables on large system?—p. 156.

Q 11 In a 4-wire, 3-phase, 2400-4000-volt distribution system in which no two feeders from station are interconnected and in which such feeders and part of the branches from feeder-ends will soon be almost entirely underground, what methods are used to locate and remedy trouble on the underground portions of such feeders?—p. 156.

Q 12 What has been the experience with underground or subway cut-outs on 2300-volt cable systems in which the manholes are occasionally filled with water?—p. 156.

Q 13 In a system of Edison 3-wire underground cable mains installed in conjunction with a system of 500-volt underground cable mains, what is the best method of taking off services from each system?—p. 157.

Q 14 What is the customary practice as to charging or not for putting underground service connection into residences and business blocks?—p. 157.

Q 15 What is a reasonable length of time to allow an underground department for introducing service and connecting meter after receipt of a customer's contract?—p. 158.

Q 16 How many times in 1906 were your cables out of service for repairs? Give character of insulation and dimensions of cable, size of copper, thickness of insulation, thickness of lead sheath, over-all diameter and approximate length.—p. 158.

Q 17 What would be the effect on a paper-insulated cable carrying 13,000 volts with a 3000-kw generator on each end, the distance between generators about five miles, if in case of attempting to parallel these generators, they should get out of step and buck each other? Would it have a tendency to destroy the cable? If so, why?—p. 158.

Q 18 How best contend with burning gas near high-tension cables? —p. 160.

Q 19 In subway construction is it advisable to place fuse boxes on the secondaries of each transformer in the manholes, several transformers being on the same feeder?—p. 160.

R

TRANSFORMERS

R 1 What is a fair ratio between the connected capacity in transformers and the actual peak load on an alternating lighting system? —p. 160.

R 2 What is the most practical method of determining the maximum load carried by transformers in service, in order that transformers of the proper capacity may be selected, thus avoiding too low capacity on one hand with consequent danger of burnouts, and too high capacity on the other hand with consequent unnecessary core loss, interest and depreciation?—p. 161.

R 3 In a business section where there is a transformer of about 150-light capacity on nearly every pole, is it better to run common secondaries and run all the transformers in bank or to run the transformers as separate units? The system is 2-phase.—p. 163.

R 4 Would it be good practice to connect in multiple the secondaries of two transformers whose primaries are connected to each phase of a 2-phase system?—p. 164.

R 5 Have 2-phase transformers been found perfectly satisfactory for small power work when installed on pole lines for use with two-phase induction-type motors up to 30 horse-power? Is the satisfaction equal to that with single-phase transformers for same work?—p. 165.

R 6 What is the smallest size of transformer advisable for use on a 3-wire secondary, feeding a few small consumers, so that any ordinary unbalancing would not be noticeable?—p. 165.

Question

R 7 What is the relative efficiency at full load of two transformers connected 3-phase to 3-phase resultant delta, compared with three transformers of equivalent total capacity connected 3-phase to 3-phase delta?—p. 165.

R 8 What percentage of their rated capacity have two transformers connected in series for 3-phase work?—p. 166.

R 9 Does it pay to test transformers in small stations of about 500-kw capacity?—p. 167.

R 10 On high-potential transformers with underground secondaries, should the frame be grounded?—p. 167.

R 11 What has been the experience in the smaller stations with grounded secondaries as to current loss and lightning effects?—p. 167.

R 12 Do you make any test of ground resistance when grounding transformer secondaries? What resistance is allowable?—p. 167.

R 13 How can secondary of transformer in lighting circuit be permanently grounded to prevent severe shock or damage in case of burnout or short-circuit between primary and secondary?—p. 168.

R 14 How can service transformers for wireless-telegraph stations best be protected against lightning?—p. 168.

R 15 What is the danger limit in temperature for oil-insulated and air-cooled transformers?—p. 169.

R 16 Have any attempts been made to cool air-blast transformers by expanding compressed air through an injector? If so, what were the results?—p. 169.

R 17 (a) Is there ever more or less than 180 degrees phase-difference between the currents of the primary and secondary of a current transformer? (b) Ditto, potential transformers?—p. 169.

R 18 Why can not current transformers be inverted as can be done with potential transformers?—p. 170.

R 19 Suggest a simple way of detecting moisture in transformer oil? —p. 171.

R 20 Give a convenient way of keeping transformer-load record.—p. 173.

8

LAMPS—ARC, INCANDESCENT, ETC.

S 1 Have any of the member companies had experience in the use of galvanized chain in suspending arc lamps; if so, how long has chain been in use, and what is the general opinion in regard to its use?—p. 174.

S 2 Is there any way of treating iron gas-caps on enclosed-arc lamps to prevent rusting?—p. 176.

S 3 Do you find large reflectors of much benefit on enclosed-arc lamps in street lightning?—p. 176.

S 4 What combination of the various kinds of inner and outer globes has proven most satisfactory for street lighting in actual practice—that is, clear outer and light opal inner, and so forth? —p. 177.

QUESTION

S 5 What are the chief troubles experienced in series alternating-current arc lamps for street-lighting system?—p. 179.

S 6 Assuming the carbons of an arc lamp to be kept at a constant distance apart, would the lamp give the same amount of light on eight amperes as indicated by an ammeter at 90 per cent power-factor as it would on eight amperes at 70 per cent power-factor? Would eight amperes always have the same heating effect in a conductor, irrespective of power-factor?—p. 179.

S 7 In testing series arc lamps do member companies find it necessary to test lamps on actual line conditions, or will an approximation of constant current suffice?—p. 180.

S 8 What is the real cause of the simultaneous hissing at the arc and drop in potential in an open-arc lamp?—p. 181.

S 9 Where series street lamps are giving considerable trouble from carbons slipping, what can be recommended as an adequate remedy?—p. 181.

S 10 What is the relative consumption of carbon in a lamp used on direct-current circuits and on alternating-current circuits?—p. 182.

S 11 What causes carbons to crystallize?—p. 183.

S 12 What proportion should the outages in street series-arc system bear to number of lamps in circuits?—p. 183.

S 13 What percentage of the income from municipal arc lamps is it necessary to expend for trimming and inspection, to give good service?—p. 184.

S 14 What are the disadvantages of using magnetite arc lamps?—p. 185.

S 15 What method has proved most practicable and convenient for closing a series-arc circuit when operated on mercury-vapor rectifiers in connection with magnetite arc lamps? The ordinary and usual method of jumping the line with series direct-current machine connected to lines, to indicate by current when open circuit has been closed, is not practicable, on account of failure of rectifier to pick up except on a closed circuit.—p. 185.

S 16 To what degree are the fumes of the flame arc noxious? Inquirer has seen a flame arc installed in a small store for illuminating purposes.—p. 185.

S 17 What policy has been adopted as regards flaming arc lamps? Are they loaned by the supplying company? Where the consumer owns the lamp does the company trim the lamps? Is any additional charge made?—p. 186.

S 18 Give average watts and volt-amperes per lamp at main 'bus-bars of switchboard for the various sizes and kinds of series-arc lamps; the figures to include all losses in translating and regulating devices and in line. State kind and size of lamps, whether alternating current or direct current; character of translating devices—motor-driven generators, mercury-arc rectifiers,

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constant-current transformers, potential transformers and regulators, and so forth.—p. 187.

S 19 Why are lamps for street lighting generally operated in series? —p. 188.

S 20 The advisability of using series incandescent lamps being under consideration, what would be considered first-class regulation on the lighting system?—p. 189.

S 21 What percentage of the income from municipal incandescent lighting (series) is it necessary to expend for renewal and inspection to obtain good service?—p. 189.

S 22 What are the weak points of renewed lamps? Do they usually have a long life? Do they lose their candle-power rapidly? —p. 189.

S 23 To what extent do frosting and sand-blasting reduce the light and life of incandescent lamps? What is the reason for the reduction in life?—p. 190.

S 24 Where there is a large number of flat-rate consumers is it good practice to give lamp renewals?—p. 191.

S 25 Do you furnish GEM units, and if so, do you renew free?—p. 192.

S 26 Do you renew Meridian or GEM units when dim or blackened or only when burned out?—p. 193.

S 27 Does it pay to install GEM lighting units (lamps and shade) at cost with free renewals?—p. 194.

S 28 Where free incandescent-lamp renewals are given, does it pay to renew what is known as the GEM lamp for use in stores, offices and business places where a considerable amount of current is consumed?—p. 195.

S 29 What success have you had with GEM units for competing with the inverted Welsbach?—p. 196.

S 30 With the voltage constant does an old, nearly burned-out, metallized-filament GEM lamp consume more current than a new one? Does frosting of a lamp bulb have any effect on the amount of current consumed?—p. 196.

S 31 From both central station and consumers' viewpoint, which is the more economical—efficiency, length of life, and price considered —the metallized-filament or the tantalum lamps on direct-current circuits?—p. 197.

S 32 Has experience proved it advantageous to use a high-efficiency lamp, selling it to meter customers at a lower rate in order to keep them satisfied?—p. 198.

S 33 What has been your experience with Nernst lamps as regards maintenance, rates and methods of charging, and so forth?—p. 198.

S 34 Where the gas company puts in arcs on a rental basis, guaranteeing the mantles, what is considered the best basis on which to put out Nernst lamps?—p. 199.

S 35 What success has been obtained in the use of Nernst, Wolfram

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and tantalum lamps, and are free renewals made of these lamps? —p. 200.

S 36 What has been the experience, as regards life, with tantalum lamps operated on direct current?—p. 200.

S 37 What is the voltage per foot of length in Moore tubes?—p. 201.

S 38 How does the candle-power per foot of length vary with the kind and density of gas in the Moore tube?—p. 201.

S 39 What is the most effective means of illumination for stores, houses or halls—distribution by small units or by a few large central ones?—p. 201.

S 40 What is the best type of diffused illumination for offices where a large amount of clerical and stenographic help is employed?—p. 202.

S 41 What is the best method of illuminating engineering offices and drafting-rooms?—p. 203.

S 42 What is the best method of determining the required illumination for a given indoor space?—p. 203.

S 43 What is the best unit to use in comparing intensities of light? —p. 204.

T

HEATING, BATTERY CHARGING AND POWER

T 1 What success has been obtained with heating appliances, especially flat-irons?—p. 204.

T 2 Have you had any complaints of electric irons burning out when operated continuously at full heat while doing work?—p. 205.

T 3 What is the most economical way of advertising and demonstrating electric irons?—p. 206.

T 4 Is heating by means of electric lamps installed in heaters and radiators an efficient method?—p. 206.

T 5 How much is the life of heating apparatus decreased when the devices are made for 220-volt circuits rather than 110-volt? —p. 206.

T 6 Should the Fire Underwriters refuse to pass an instantaneous water heater of 20-ampere capacity that loses less than 0.5 per cent of the current through the water as a ground?—p. 207.

T 7 What success is being obtained in pushing the substitution of electrically-heated devices in place of gas or steam-heated devices in industrial work?—p. 207.

T 8 Is there much demand for small electric furnaces for fine brass, bronze and other alloy work?—p. 207.

T 9 Chemists can use considerable current for electrolytic and heating work. Is any effort being made to increase such use? —p. 207.

T 10 Statements were made in a recent paper that several companies were prepared to quote very low rates for electrochemical

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processes on off-peak business. Has any progress been made in closing up business of this nature?—p. 207.

T 11 Has much progress been made in installing motors for small ice or refrigerating machines?—p. 208.

T 12 Is it profitable for a company to advocate small motors, such as one-eighth, one-quarter and even one-half horse-power?—p. 208.

T 13 Should a canvasser be expected to explain details of belting and shafting to a prospective motor purchaser, and if not, who should?—p. 209.

T 14 Give figures to be used to show the advantage of electric power over steam or other power.—p. 211.

T 15 Having a 2-phase, 4-wire system, is it economical and practical to operate single-phase motors?—p. 212.

T 16 Which motor has the better power-factor, the single-phase or the 2-phase motor?—p. 213.

T 17 Which is the more efficient on a 2-phase, 4-wire system—single or 2-phase motor, considering the small extra expense of connecting a 2-phase motor?—p. 213.

T 18 Are single-phase elevator motors commercially successful?—p. 214.

T 19 Is the control of a single-phase elevator motor positive in its action, or does the elevator operator have to try two or three times to stop at a floor?—p. 214.

T 20 (a) What is the best type of brake for electric hoists? (b) Best type of emergency brake? (c) Weak points of electric cranes? —p. 214.

T 21 Can an ordinary single-phase motor be reversed, and how?—p. 214.

T 22 Can a 133-cycle motor be easily changed to 60 cycles, and how? —p. 216.

T 23 Why do some central stations have difficulty in selling single-phase motors?—p. 217.

T 24 With generating units of 1000-kw capacity, Tirrill regulators and ample copper in feeders, how large size of single-phase squirrel-cage motors can be used without seriously affecting the lighting regulation? The load on generators is mixed lighting and power, but no lights are installed on power feeders.—p. 218.

T 25 Why are nearly all the central-station companies in the largest cities in this country objecting to the installation of small-size polyphase motors?—p. 218.

T 26 Our station is only a small one and we have lately had a good deal of trouble with line disturbances owing to the starting of polyphase motors. Is the same trouble likely to occur with single-phase motors?—p. 219.

T 27 I have often heard it stated that a single-phase motor is cheaper to install than a polyphase motor. How can that be, when the price of the single-phase motor is so much higher than that of the polyphase motor?—p. 220.

T 28 Given the full-load current of a motor, what rule do you apply in determining the fuse capacity to be used? (a) For direct-current motors? (b) For alternating-current, single-phase motors (Wagner type)? (c) For polyphase motors?—p. 221.

T 29 Is it desirable to install and advocate the use of 2300-volt, 3-phase induction motors? If so, at what sizes have you found it advisable to change from 110 and 220 to 2300 volts?—p. 222.

T 30 How are 2300-volt motors installed and wired so as to be absolutely safe to apparatus and satisfactory to Underwriters?—p. 222.

T 31 What is the best argument in favor of motors as against fuel-oil engines up to, say, 25 horse-power?—p. 222.

T 32 What is the best way of obtaining variable speed on machine tools using alternating-current motors, and which are the best types of motor to use, single and polyphase?—p. 223.

T 33 Are multi-speed alternating-current motors satisfactory in starting with full load? Load to be power pumps.—p. 223.

T 34 What is the best method to determine whether we have the two phases on a 4-wire service or whether all four wires are connected in on the same phase, primary side? Can it be determined with a voltmeter, and if so, what readings should be obtained? Service furnished, 220-volt, 2-phase.—p. 223.

T 35 To what extent will the efficiency of a motor be affected if operating under full load with surrounding temperature 90 degrees?—p. 225.

T 36 Investigating a direct-current motor-starting rheostat, we discovered a large momentary current in starting. For instance: a 30-hp, 110-volt motor, tested at manufacturer's works, meets all requirements; after installing under same conditions the motor draws 400 amperes from the line at starting. What is the cause?—p. 225.

T 37 The strength of a solenoid depends upon the ampere-turns. If the turns and amperes are kept constant, does a change in power-factor have any effect?—p. 226.

U

METERS

U 1 In view of the simple and accurate means of determining the load connected to recording wattmeters by counting the disc revolutions, would it not be well to have a small window opposite the disc in the cover of all meters, such, for example, as on the Thomson high-torque meter? This would avoid the necessity of unsealing the meter every time a disc reading is desired.—p. 226.

U 2 From the meter reader's viewpoint, what diameter of meter dial is the best?—p. 228.

U 3 What shape of hand is the most advantageous for a meter dial?—p. 229.

U 4 In small-capacity meters both sides of the circuit pass through the

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meter, while in large meters a potential tap only is brought out. At what capacity is it best to draw the line?—p. 229.

U 5 In various makes of meters the binding-posts for the connecting wires are so arranged that a screwdriver must be used either from the front, sides, top or bottom of meter. Which is the most desirable position?—p. 230.

U 6 What are the principal difficulties with and objections to chemical meters of the direct-reading type, and the advantages, if any, as compared with the motor or moving-element type?—p. 232.

U 7 Give the shortcomings of the Bastian wattmeter. What are the points in favor of this meter?—p. 233.

U 8 Are prepayment meters entirely successful? If not, why?—p. 233.

U 9 Has the installation of electric prepayment meters been satisfactory, or warranted by any accruing benefits?—p. 234.

U 10 Where companies make minimum charge what provision is made for prepayment meters when the amount deposited is less than minimum?—p. 234.

U 11 Are two-rate meters in successful operation on installations requiring 800 to 1000 kilowatts? What is the best method of installing?—p. 235.

U 12 What has been your experience with the Wright discount meter on alternating-current motors?—p. 235.

U 13 If Wright demand indicators are used to ascertain the demand, what should be the limit; *i. e.*, for how long a period should they be adjusted before the maximum is registered?—p. 236.

U 14 Are maximum-demand indicators, of the Wright type, successful on single-phase, alternating-current power installations for establishing the discount on demand rates?—p. 236.

U 15 What method is used in determining capacity of meter placed on installations where the ordinary load is only a small part of the total installation as in residences?—p. 237.

U 16 Should service and house cutouts be fused to same ampere capacity as the meter, assuming that the capacity of the meter is sufficient for connected load? In the event of an overload, will the fuses protect the meter from a burnout?—p. 238.

U 17 What is the best protection against lightning for Thomson meters on a 3-wire, direct-current system?—p. 239.

U 18 If the meter is grounded, what effect does it have on the running of the meter? The meter is a 2-wire, type K Fort Wayne. The service being connected to a 3-wire secondary 'bus on pole line, the side to which the shunt of the meter is connected is, therefore, grounded.—p. 239.

U 19 With a ground of 108 volts on house lines and resistance of voltmeter 13,100 ohms, line-voltage 116, how are resistance of ground and loss in amperes computed?—p. 240.

U 20 What has been your experience with direct-current meters for power on 220-240-volt, 3-wire circuits?—p. 240.

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U 21 Will a recording wattmeter that creeps under no load record the load plus the creep during load period?—p. 240.

U 22 What method is used to determine if the constant marked on meters is correct?—p. 241.

U 23 Is there any simple way of determining the strength of a permanent magnet, such as is used in type K Fort Wayne meters?—p. 241.

U 24 What difference, if any, is shown in the action of a meter having a short-circuit in the armature and one having a short-circuit in commutator?—p. 242.

U 25 A rotary transforms from direct current to alternating current, and alternating current is used for meter testing. (a) Will meters tested on this current register the same when connected to a main feeding direct from an alternator? (b) If not, what will be the error?—p. 242.

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V 9 What general or specific rules do you follow in the matter of making investments for installation incident to getting new business? Please divide your answer as follows, stating method in each case: (a) Do you make free sign installations? (b) Do you make free motor installations or do you make use of a loan proposition? (c) Would you make the investment

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necessary to change an elevator from hydraulic to electric? (d) Do you do any wiring free of charge (residences or stores)? Do you supply first installation and free renewals of special lamps, such as the high-efficiency and Nernst lamps? (e) In shutting down isolated plants do you aid in financing the electric installation, and how?—p. 271.

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W 3 In cases where a maximum-demand meter is installed, do you figure each month's bill on the demand shown for that month, or on the maximum demand for the year?—p. 287.

W 4 With a demand system of charging, how do you assess the maximum demand of residences and customers for whom you do not install a demand meter?—p. 288.

W 5 What is the best method of adjusting the minimum charge, and how is the subject of minimum charge best presented to a customer without actually calling it a minimum charge?—p. 289.

W 6 In cases where prepayment meters are installed do you require consumer to sign contracts or is any minimum exacted? How is matter handled?—p. 291.

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W 8 What effect has the demand system of charging had on your load curve? Has it improved your load-factor or net earnings sufficiently to justify a reduction in the base rate?—p. 291.

W 9 Our company is operating a 24-hour all-meter circuit. How best can we give our customers a low rate for current used off the peak and still maintain our maximum rate during the peak load without incurring too much expense for changes?—p. 291.

W 10 Where flat-rate consumers use their lights longer than their contracts allow and notices to such effect have been sent out without avail, what can be done where gas competition is strong?—p. 292.

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facture the current? Our schedule is very unsatisfactory.—p. 294.

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W 16 A small station of 670-kw capacity has 180 kilowatts on the water-wheel and the remainder on steam. Average peak load is 350 kilowatts. Water is obtained from a canal that has much anchor ice. A mill on the same canal, using water-power only, wishes 125 horse-power for auxiliary service when handicapped by anchor ice. When anchor ice sets in, the station wheel goes out of business before the mill wheel. What is a fair minimum annual bill and what would be a fair daily charge for ten hours; coal $4.50 a ton, lighting rates $0.14, power rates down to $0.0325?—p. 296.

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Parrish, H. Clyde, Great Barrington Elec. Lt. Co., Great Barrington, Mass.
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Patterson, W. R., Plant Engr. Western Elec. Co., Hawthorne, Ill.
D 5.
Peterson, Edward, Treas. Crookston Wtr. Wks., Pr. and Lt. Co., Crookston, Minn.
B 1, 2, 3, 4, 5, 6. F 4. G 7. J 20. K 15. T 1. Y 9, 11.
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U 42.
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V 10.
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H 4.
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F 2, 3, 4.
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S 16, 17, 25, 26, 27, 28. U 39, 40, 41, 43, 44, 45, 46. V 6, 14, 20, 21, 22. W 2, 4, 24. Y 6, 7, 8, 9, 10, 11, 25. Z 1.
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Rettew, G. H., Gen. Mgr. Helios Mfg. Co., Bridesburg, Philadelphia, Pa.
S 3, 4, 5, 6, 7, 9, 11, 12, 16, 17, 19. U 6, 7.

Reynolds, L. K., Denver Gas and Elec. Co., Denver, Colo.
W 27.
Rice, H. H., Mgr. Waverly Dept. Pope Motor Car Co., Indianapolis, Ind.
E 3.
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Z 3.
Robinson, James L., Albany, N. Y.
P 42.
Rodman, Hugh, Storage Battery Dept. Westinghouse Machine Co, Pittsburg, Pa.
L 2, 3, 4, 5, 6, 7, 9.
Rollins, N. A., Chicago Edison Co., Chicago, Ill.
A 7. J 8. K 23.
Roper, D. W., Chicago Edison Co., Chicago, Ill.
Q 2.
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F 1.

S

Sargent, F. C., Elec. Engr. Malden Elec. Co., Malden, Mass.
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V 11.
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U 41, 43, 44, 48. V 10, 13, 21, 22. W 11, 15, 27. Y 2, 6, 8, 10, 13. Z 1.
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S 22.

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C 5. F 6, 7. H 3. I 5, 8.
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L 6.
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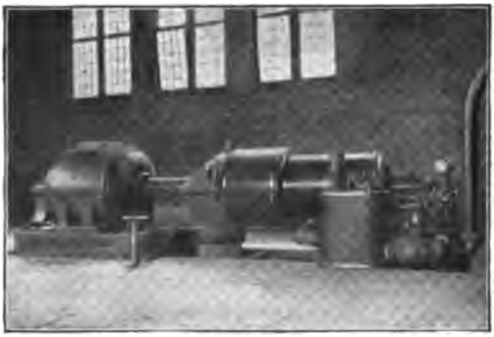

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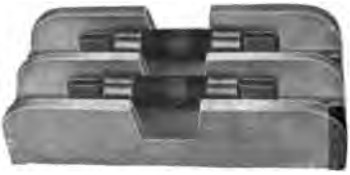

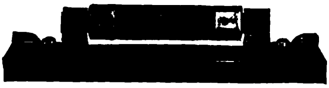

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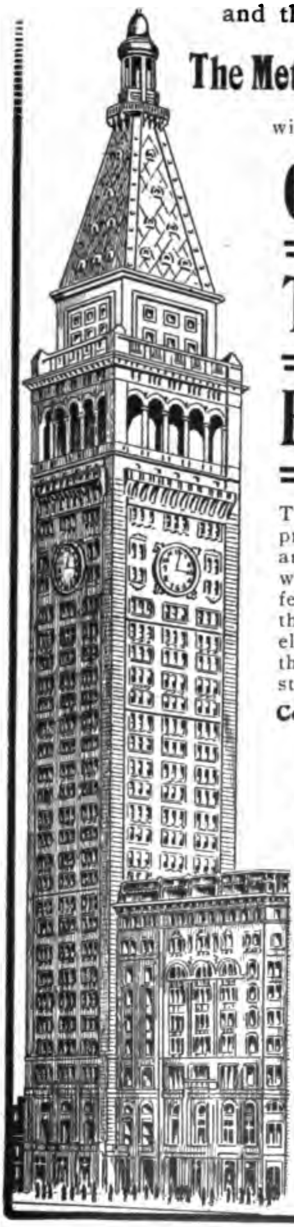

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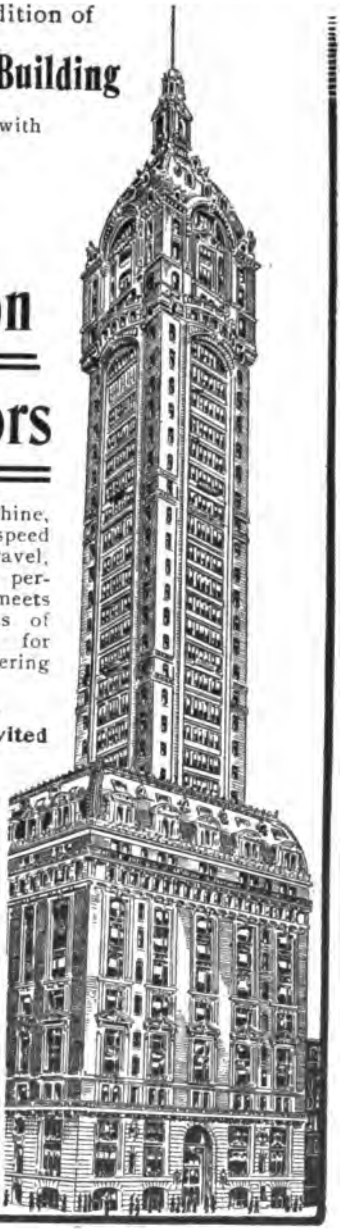

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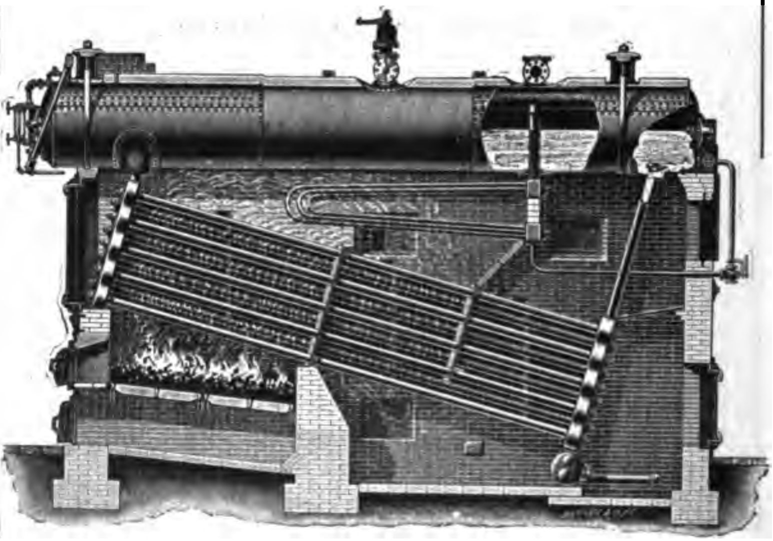

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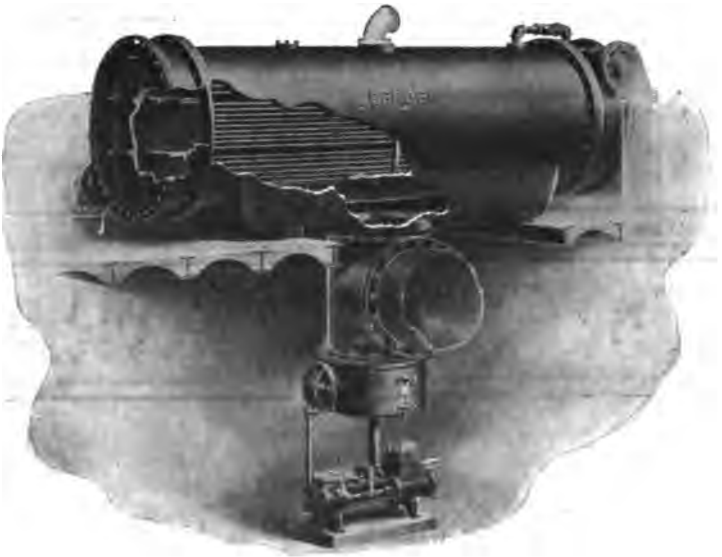

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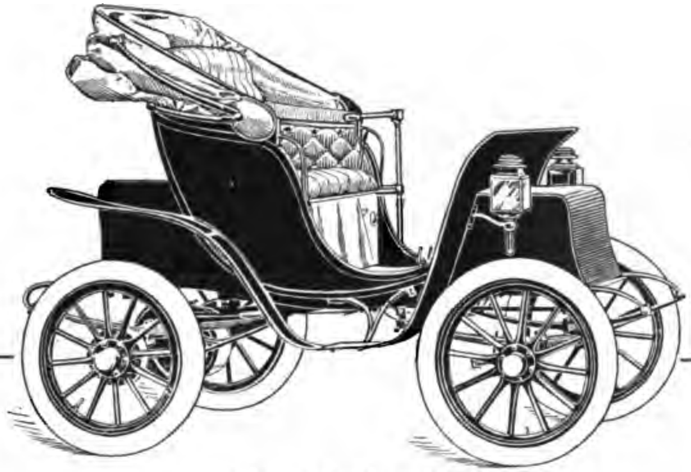

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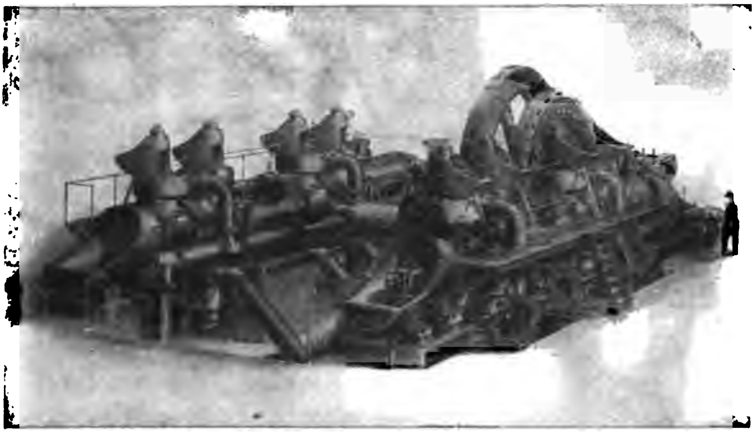

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